Engineering Library

Motorship

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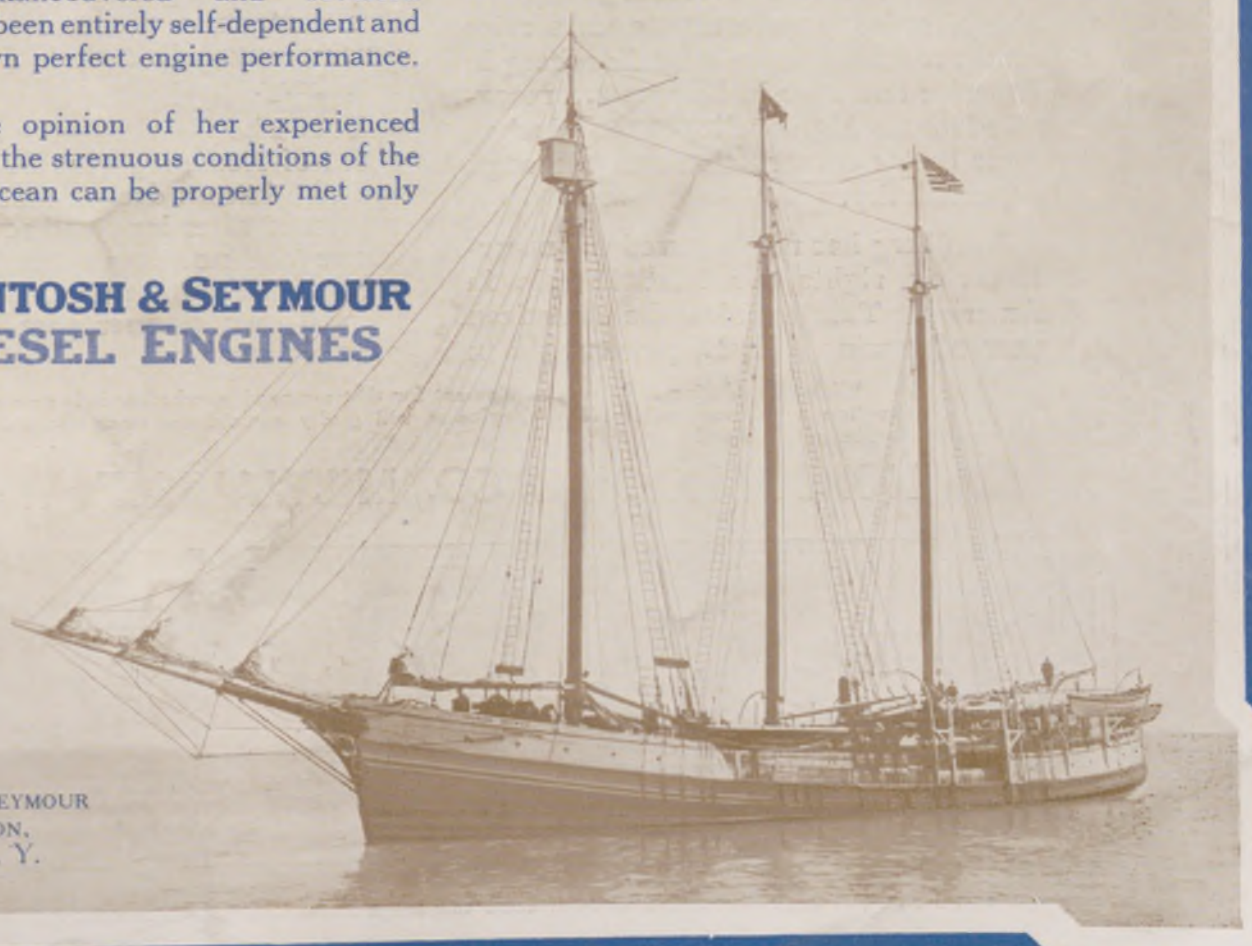
Motorship "Charles Brower"

Power: 300-b.hp. 6-cylinder McIntosh & Seymour directly reversible full Diesel Engine. Owners: H. Liebes & Co., San Francisco.

FOR two summers an Alaskan and Arctic fur trader, this 569-ton schooner-motorship has dodged ice floes, manoeuvered and reversed quickly, been entirely self-dependent and has shown perfect engine performance.

In the opinion of her experienced Captain, the strenuous conditions of the Arctic Ocean can be properly met only by

McINTOSH & SEYMOUR
DIESEL ENGINES



McINTOSH & SEYMOUR
CORPORATION,
AUBURN, N. Y.

NOV. 1926

PRICE 35c

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ARTICLES on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

Motorship

ILLUSTRATIONS of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

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Vol. XI | November, 1926 | No. 11

First Shipping Board Conversion Ready

Pioneer Vessel of Fleet of Fourteen Has Double Acting 2-Cycle Diesels of All American Design and Manufacture and Will Go on Service Immediately

TAMPA, first ship of the government's $25,000,000 Dieselization programme and first sea-going motorship with a double acting Diesel of all American design and manufacture, underwent her dock trials at Newport News during October, and is scheduled to go into service by the beginning of November. It is understood, at the time of our going to press, that no definite allocation of the vessel has yet been made to any operator. It is probable, however, that when the allocation is made, TAMPA will be operated out of New York for a time, either in the South America trade or in the transatlantic trade to European ports.

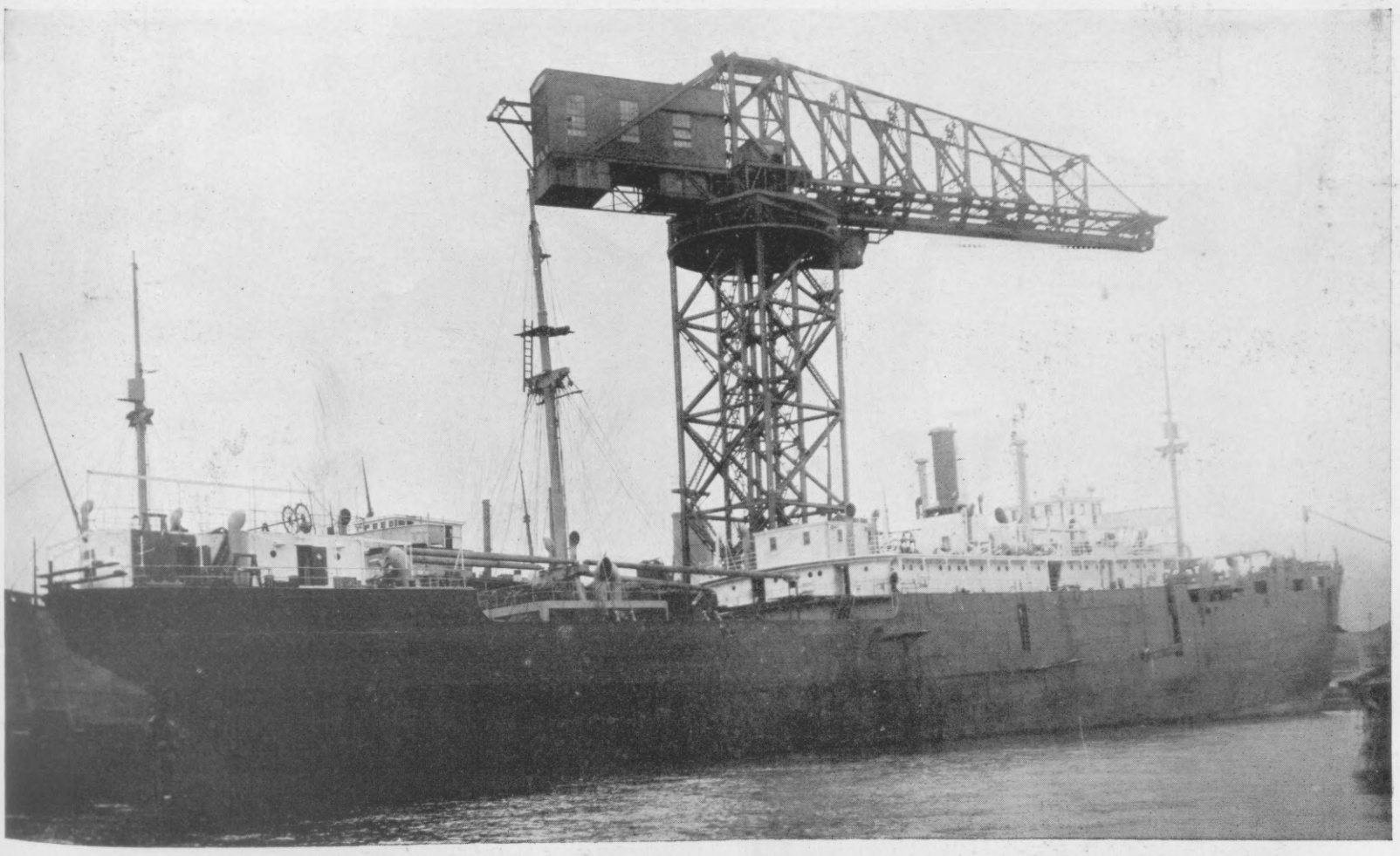
The vessel is a unit of the SEMINOLE class and the work of installing the 2900 b.hp. Worthington double acting 2-cycle main engine, as well as the auxiliary machinery, has been carried out by Newport News Sb. & D. D. Co., Newport News, Va.

Following are the vessel's principal characteristics after conversion:

"Converted" Characteristics of Tampa

Length overall	416 ft. 0 in.
Length b.p.	402 ft. 0 in.
Beam molded	54 ft. 0 in.
Depth molded to shelter deck	33 ft. 9 in.
Gross register (estimated)	5,950 tons
Net register (estimated)	3,665 tons
Construction	Longitudinally framed
Spacing of transverses	10 ft. and 11 ft. 0 in.
Normal mean load draft	26 ft. 10¾ in.
Deadweight capacity, about	9,400 tons
Power of main oil engine	2900 b.hp.
Normal speed, service condition (about)	11½ knots

The conversion work has been of an exceptionally complete nature and has involved the removal of the whole of the steam main and auxiliary machinery—in other words the gutting of the engine room—and the installation of the new Diesel machinery. The whole of the deck machinery has been modernized and brought thoroughly in line with best electric practice for the rapid handling of cargoes. Extensive alterations have been made in the accommodations, resulting in extra cargo carrying space. The whole of the midship houses—the ship is of three island type—have been rearranged to accommodate passengers as well as officers. The bridge equipment has been brought into line with best practice. The conversion will be fully described in a forthcoming issue.



Tampa, first completed unit of the Government's $25,000,000 *Dieselization programme is to take her place on competitive ocean trade routes*

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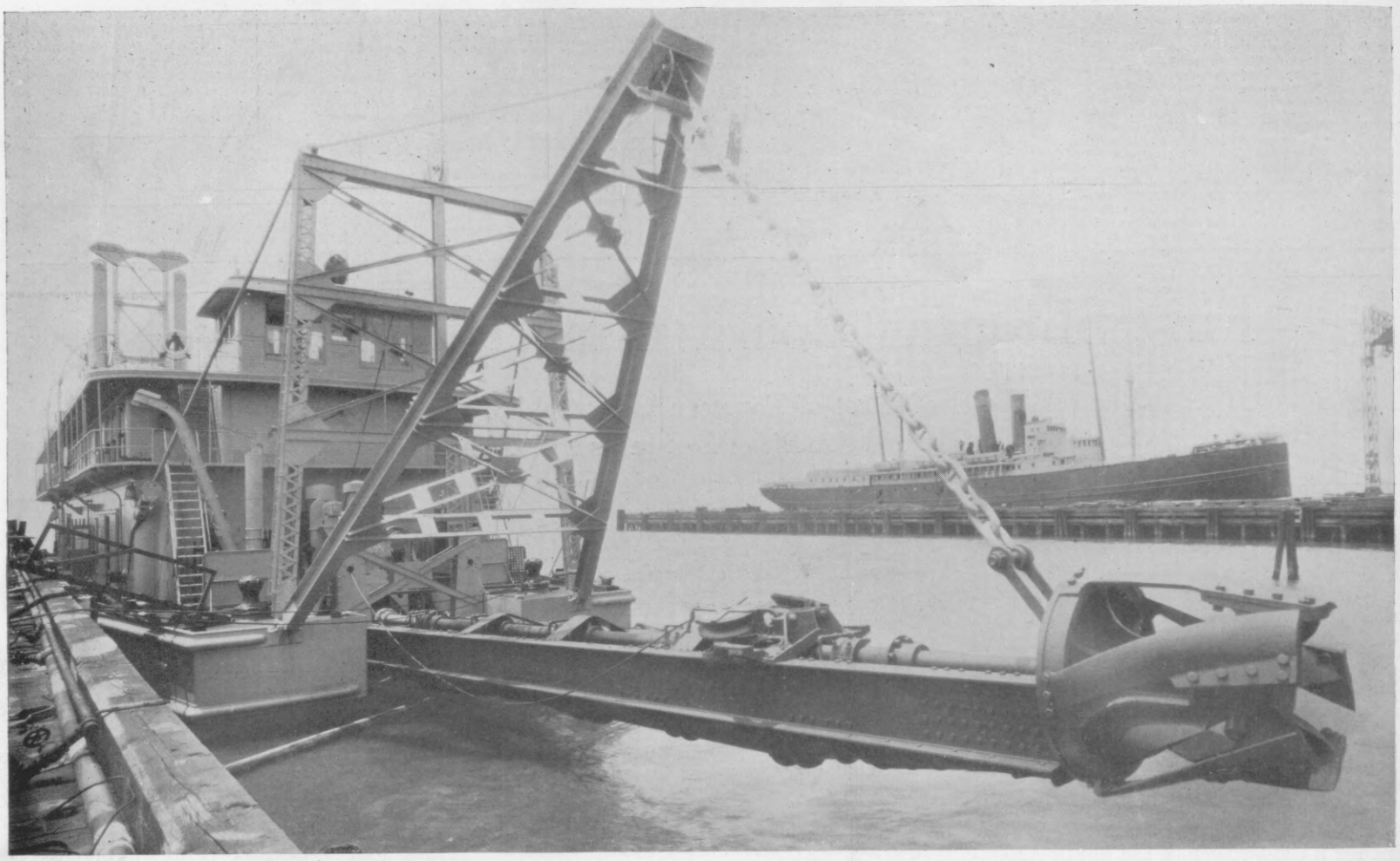
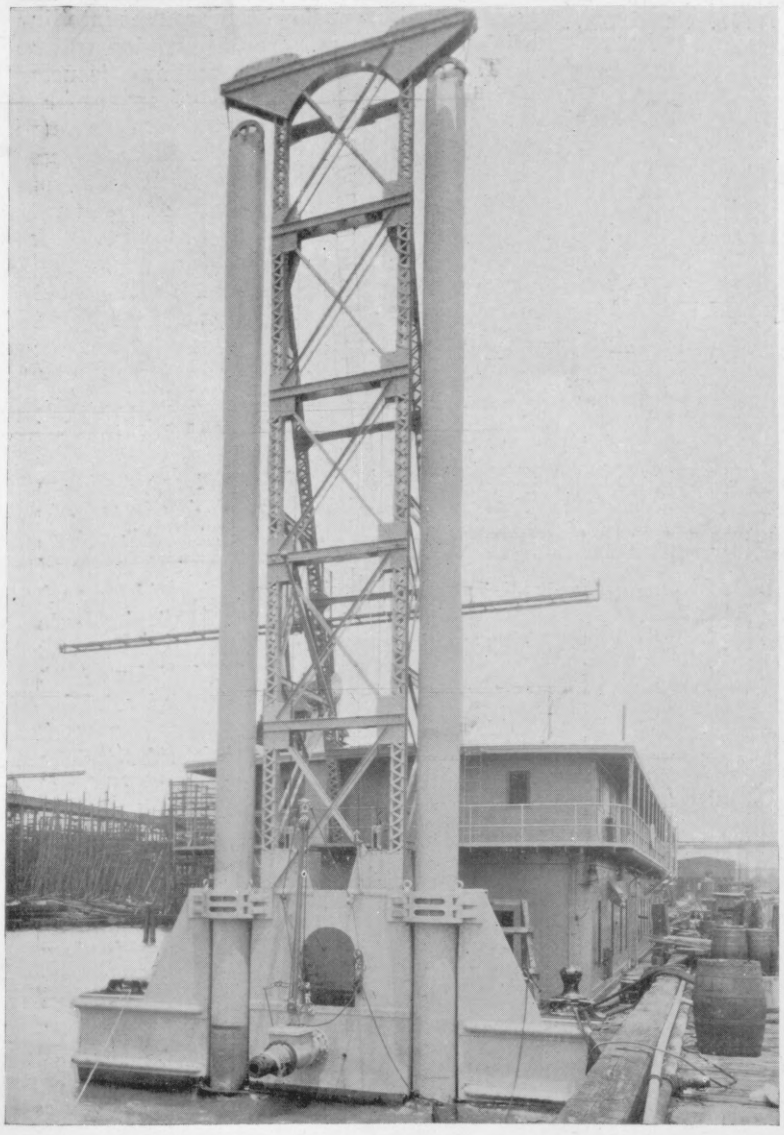


Big Diesel Dredge Raymond is equipped with a powerful cutter at the end of her dredge ladder which is 57 ft. 6 in. long



The two spuds, of steel construction, are each 75 ft. long

Shows the compact appearance of this new Diesel dredge

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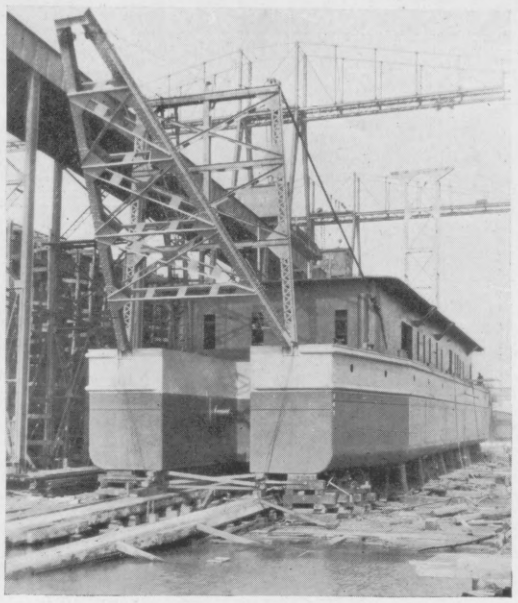
Big Pipeline Dredge on Delaware River

Has 10-Cylinder 1100 hp. Diesel Direct Coupled to 20-in. Centrifugal Dredge Pump

RAYMOND, Diesel engined pipeline dredge designed to operate on the Delaware River, represents one of the latest additions to the rapidly growing fleet of modern oil engined powered dredges owned by the U. S. Army Engineers. Following the practice first incorporated in the C. B. HARRIS, pioneer modern pipeline dredge built by the War Department, RAYMOND has a centrifugal dredging pump direct connected to an 1100 b.hp. Diesel. All the rest of the machinery is electrically operated, power being supplied by a pair of 585 kw. Diesel generators. The first duty assigned to the vessel on her commissioning is to make a fill behind the Kill Kahool Dyke on the New Jersey side of the Delaware practically opposite Wilmington, and after this she will operate near Fort Mott. The fill is made with the assistance of hopper dredges. RAYMOND proceeds on station and digs a deep dump pit or basin, which is kept filled by the hopper dredges and is discharged through her pipe line.

RAYMOND is constructed of steel under the rules of the American Bureau of Shipping. Her hull is of conventional pipeline dredge form with a recessed forward end to take the dredge ladder. This forward portion narrows somewhat towards the front end of the ship. Aft, the plating is arranged to knuckle and to run up on the box stern to a point practically at waterline level. The main and the principal auxiliary machinery is all located within the hull, the main deck having large wells to allow for cylinder heads and other portions of the machinery which project above main deck level. A large steel house is built over the major portion of this deck, leaving a walkway on either side and space at the forward end for mooring capstans and cutter motor gear and at the aft end for the two spuds and their gear. The top of this house forms an upper deck, and on the upper deck accommodations for the crew are arranged in another house which covers



Fore end recess for dredge ladder

the whole of the deck except for narrow walkways. This house is of wooden construction and its top forms a hurricane deck clear fore and aft except for boats, skylights, and a control house at the forward end. Contrary to the arrangement adopted in some large pipeline dredges, of which Portland's large dredge CLACKAMAS is an example, the A frame for the dredging ladder, the gallows frame and the hoisting frames for the spuds are not incorporated longitudinally in the hull structure.

Characteristics of Dredge Raymond

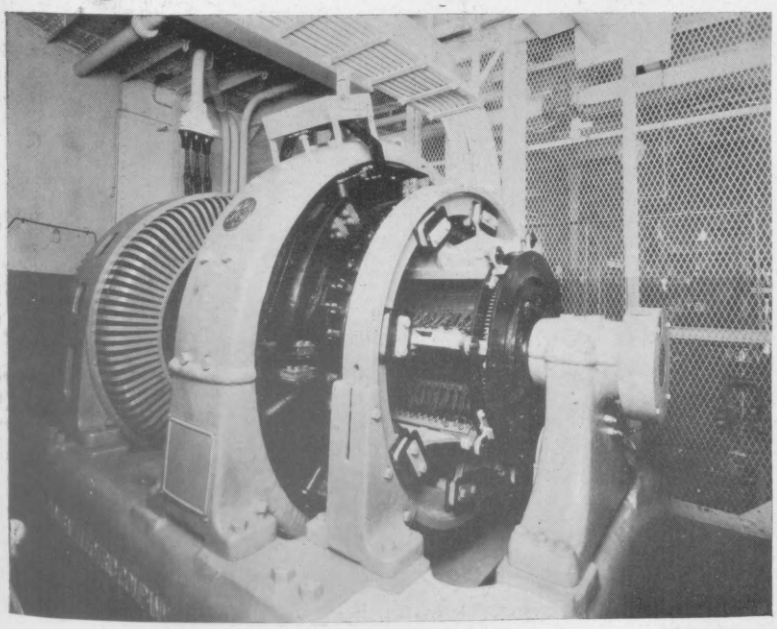
Length molded	177 ft. 6 in.
Length overall	235 ft. 0 in.
Beam molded	40 ft. 0 in.
Beam overall	41 ft. 3 in.
Depth molded	14 ft. 8 in.
Draft (mean with ladder up)	9 ft. 0 in.
Pipeline diameter	20 in.
Capacity (16 per cent solids)	5000 tons per hr.
Pump power	1100 b.hp.

The A frame for the dredging ladder is 42 ft. 3 in. long, consisting of two inclined columns each constructed of one 15 in. x $\frac{3}{8}$ in. web plate, four 5 in. x $3\frac{1}{2}$ x $\frac{3}{8}$ in. angles and two 11 in. x $\frac{3}{8}$ in. face plates. The columns are pin connected at their lower ends to cast steel bases and are connected together by double 5 in. x $3\frac{1}{2}$ in. x $\frac{3}{8}$ in. horizontal angle bars and 3 in. x 3 in. x $\frac{3}{8}$ in. double diagonal angle bar bracings. On top of this frame are fitted five 30 in. sheaves to take 1 in. diameter hoisting wire for the ladder.

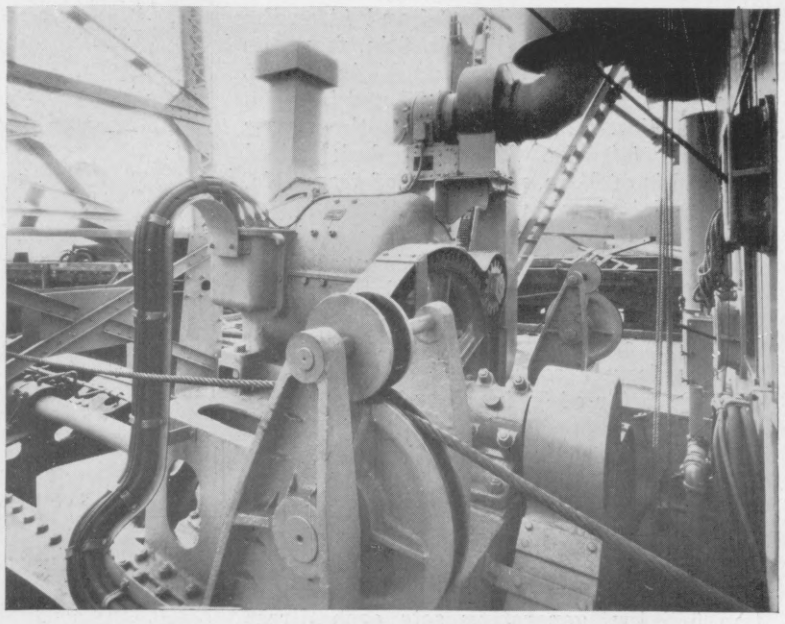
The gallows frame is 31 ft. 3 in. long, consisting of two inclined latticed columns, each constructed of two 12 in. x 3.047 in. x 25 lb. channels and $2\frac{1}{4}$ in. x 5/16 in. single lattice bars. The columns are pin connected at the lower ends to cast steel bases and braced strongly together. On top of the frame, are two cast steel seats for the stayrods from the A frame, which are $3\frac{1}{4}$ in. diameter, and for the stayrods connected to the hull of the dredge which are $3\frac{1}{2}$ in. diameter.

Hoisting frames for the two spuds consist of two columns extending to 68 ft. 6 in. above the main deck and located 4 ft. $8\frac{3}{4}$ in. off the center line on port and starboard sides. Each column is built of two 10 in. x 2.6 in. x 15.3 lb. channels, supported by a backstay of two 8 in. x 2.26 in. x 11.5 lb. channels, all held together by means of tie plates and lattice bars.

The two spuds are 75 ft. long, with an outside diameter of 34 in. They are built of $\frac{3}{4}$ in. steel plates with double riveted seam straps and treble riveted butt straps, each spud being stiffened with six continuous 4 in. x 3 in. x $\frac{1}{2}$ in. angles, and by seven $\frac{3}{8}$ plate diaphragms with 3 in. x 3 in. x $\frac{3}{8}$ in. angle clips. At the top of the spud a single 30 in. sheave is fitted to take a 1 in. diameter wire hoisting rope, lead to the main hoisting machine fore end. Transverse system of framing is adopted throughout the hull structure and the side frames are 6 in. x $3\frac{1}{2}$ in. x $\frac{3}{8}$ in. angles spaced 30 in.



A powerful motor generator supplies current for a booster pump



Dredge cutter is driven by fan cooled motor through spur gearing

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heel to heel, lapped on to deep floors and joined to deck and floor beams by 3/8 in. plate brackets. Bilge plates are 7/16 in. throughout and the bilge radius is 2 ft. 6 in. Bottom side, and ladder well plating is 3/8 in., bow plating of the same dimensions, and transom plating 1/2 in. Longitudinal seams are lapped and double riveted, and the butts in the bottom plating are the same, but the butts in the side and bilge plating are strapped and double riveted.

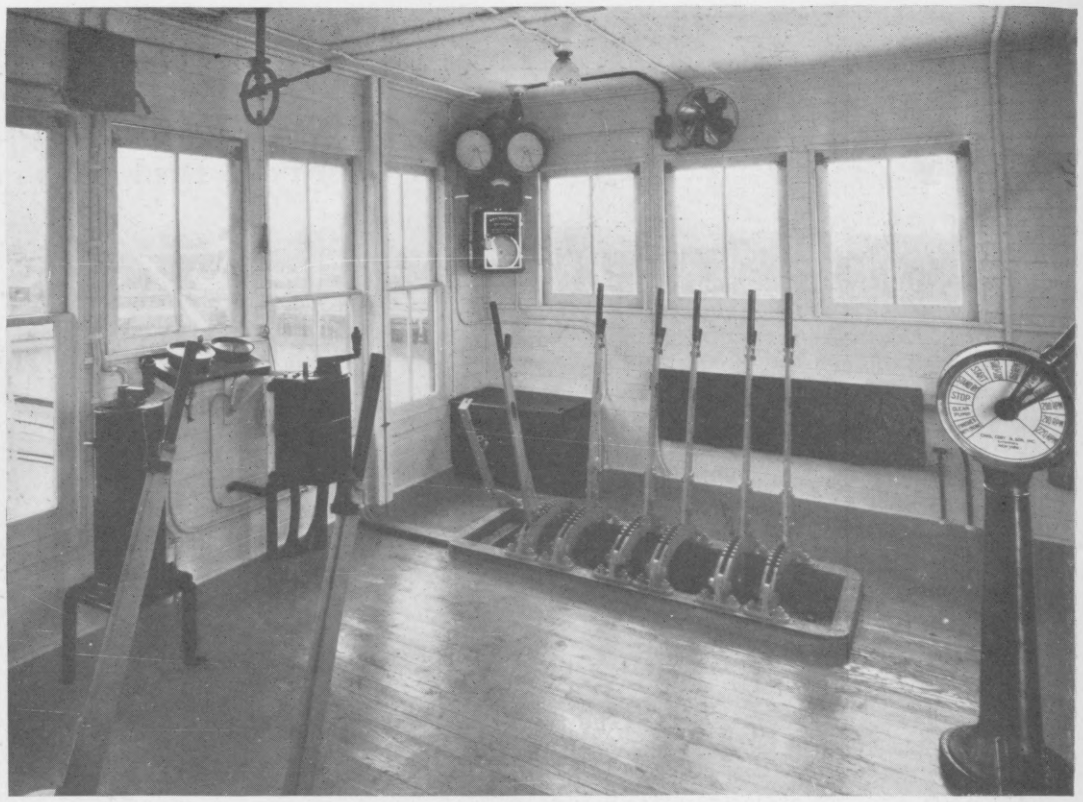
Floors are worked transversely from frame No. 8, the aft bulkhead, to frame No. 68 the extreme fore end of the hull, spaced 30 in. heel to heel and are of 10 in. x 2.7 in. x 20 lb. channels, 4 in. x 3 in. x 3/8 in., 3 in. x 3 in. x 3/8 in. 3 in. x 3 in. x 5/16 in. angles, with 3/8 in. lightened plates. Aft of frame No. 8 the floors are worked longitudinally and spaced also 30 in. heel to heel. They are built of 8 in. x 20 lb. channels, 6 in. x 3 1/2 in. x 3/8 in. and 3 in. x 3 1/2 in. x 3/8 in. and 3 in. x 3 in. x 3/8 in. angles with 3/8 in. lightened plates. Between frames Nos. 9 and 24, 26 and 43 and 45 deep floors are fitted inboard of longitudinal bulkheads to suit the engines and dredging pump. Outboard of the longitudinal bulkheads, deep floors are fitted at frames Nos. 11, 13, 15, 17, 19, 24, 27, 29, 31, 33, 37, 39, 41 and 44 on both sides, at frames Nos. 22 and 23 on the starboard side and on frame No. 21 on the portside. Floors at frames No. 21 on the starboard side and No. 23 on the port side are oiltight outboard of the longitudinal bulkhead and floors at frames Nos. 22 and 24 are watertight between inboard longitudinal engine girders.

Engine girders are of 3/8 in. lightened plates connected to the shell by 3 in. x 3/8 in. angles. Top plates in way of the engines and dredge pump are 5/8 in., connected to the girder by 5 in. x 3 1/2 in. x 7/16 in. angles. Girders between frames Nos. 8 and 25 are 3 ft. high, between frames Nos. 25 and 38 are 5 ft. high and between frames Nos. 39 and 46 4 ft. high, and 4 ft. 10 in. high to suit the engine and dredging pump.

There are two main longitudinal bulkheads fitted 10 ft. from the center line between frames Nos. 8 and 57 on port and starboard sides, watertight and oiltight only between a few frames as required. An oiltight longitudinal bulkhead extends between frames Nos. 25 and 36 on the port side, located 14 ft. 6 in. from the center line, and between frames Nos. 25 and 44 on the starboard side located 17 ft. 6 in. from the center line. This plating is 3/8 in. except between frames Nos. 8 and 25 and between frames Nos. 50 and 57 where the center strake is 5/16 in. The main deck is laid flat and is of 3/8 in. plating aft of frame No. 65 1/2 and 1/2 in. forward of that.

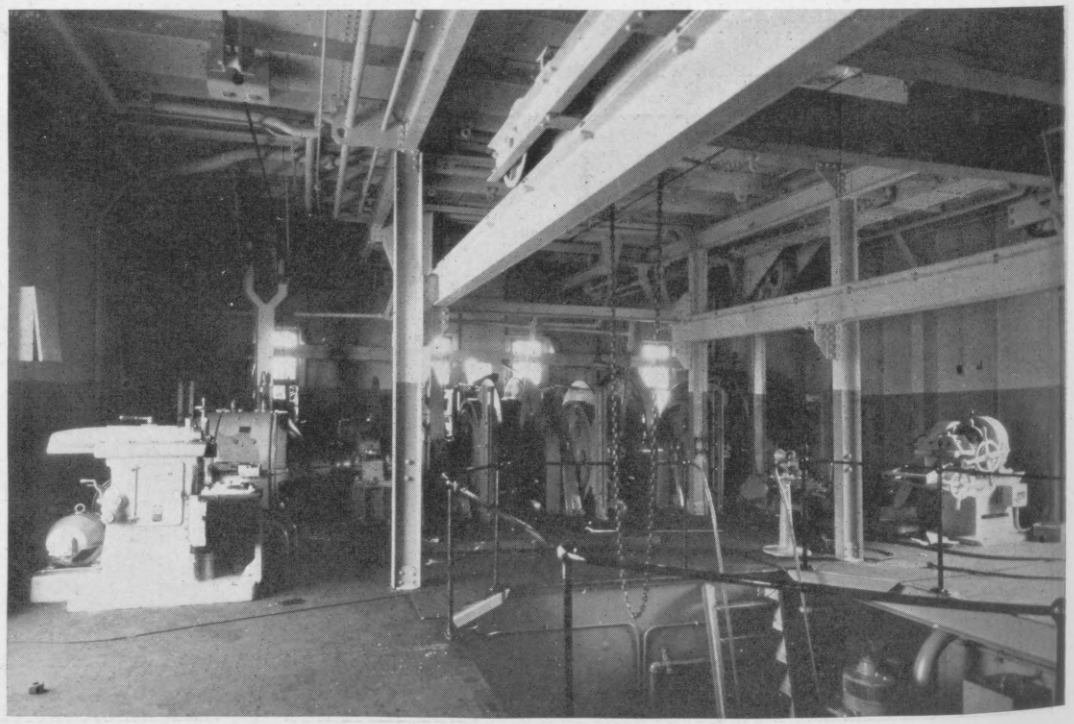
Watertight bulkheads are located on frames Nos. 8, 50, 52 and 57, constructed of 5/16 in. plate, except the latter which is of 3/8 in. plate. Oiltight and watertight bulkheads are fitted on frames Nos. 25 and 44, the former constructed of 5/16 plate, and the latter of 3/8 in. plate in way of the fuel oil tank.

These bulkheads are continuous to the main deck and divide the hull into the compartments necessary for housing the pump, the main and auxiliary engines, etc. Starting from the aft end of the ship, the compartment between frames 8 and 25 houses two 585 kw. generating sets each direct driven by an 8 cylinder McIntosh & Seymour Diesel. These are enclosed also by two non-watertight longitudinal bulkheads. In the compartments thus formed, on the port and starboard side are contained lubricating oil pumps, an engine bilge pump and distillate transfer pump. The starboard side compartment has also mufflers from the two generator engines and one muffler from the main pump engine all arranged horizontally, two on the starboard side and one on the port side of the compartment. This compartment really forms an entirely separate engine room with necessary auxiliaries. The generator sets deliver current for the whole of the auxiliary machinery on the ship, including an 800 kw. motor generator driving an 1150 hp. booster plant, and the windlass which handles the dredge ladder.



Control for dredge pump, hoisting winch, cutter, and spuds is centralized in a roomy house

The main pump engineroom is located between frames 25 and 44. Bulkhead 44 is not continuous from side to side of the ship but only from the starboard side to the port inboard watertight bulkhead. The dredge pump is located in a compartment between bulkheads 44 and 50 so that actually the main McIntosh & Seymour pump-operating Diesel and the pump itself are in one big watertight compartment although by virtue of a watertight door in the longitudinal bulkhead between frames 44 and 50, the pump can be isolated. Fuel oil tanks surround the main engineroom which in addition to the 10-cylinder 1100 hp. Diesel contains a bilge pump, fresh water circulating pumps, fire pump, fuel oil pumps, and an air compressor. An unusually extensive auxiliary operating equipment is added to



All hoisting and warping is carried out by means of a powerful windlass forward

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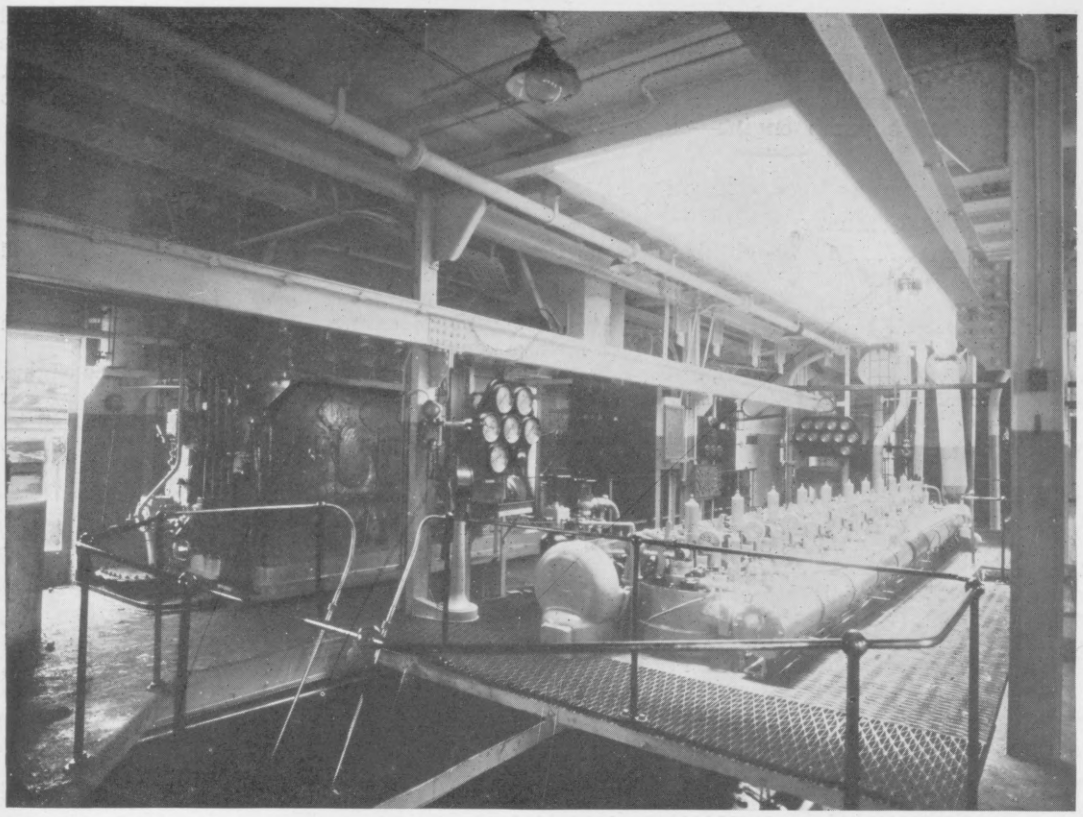
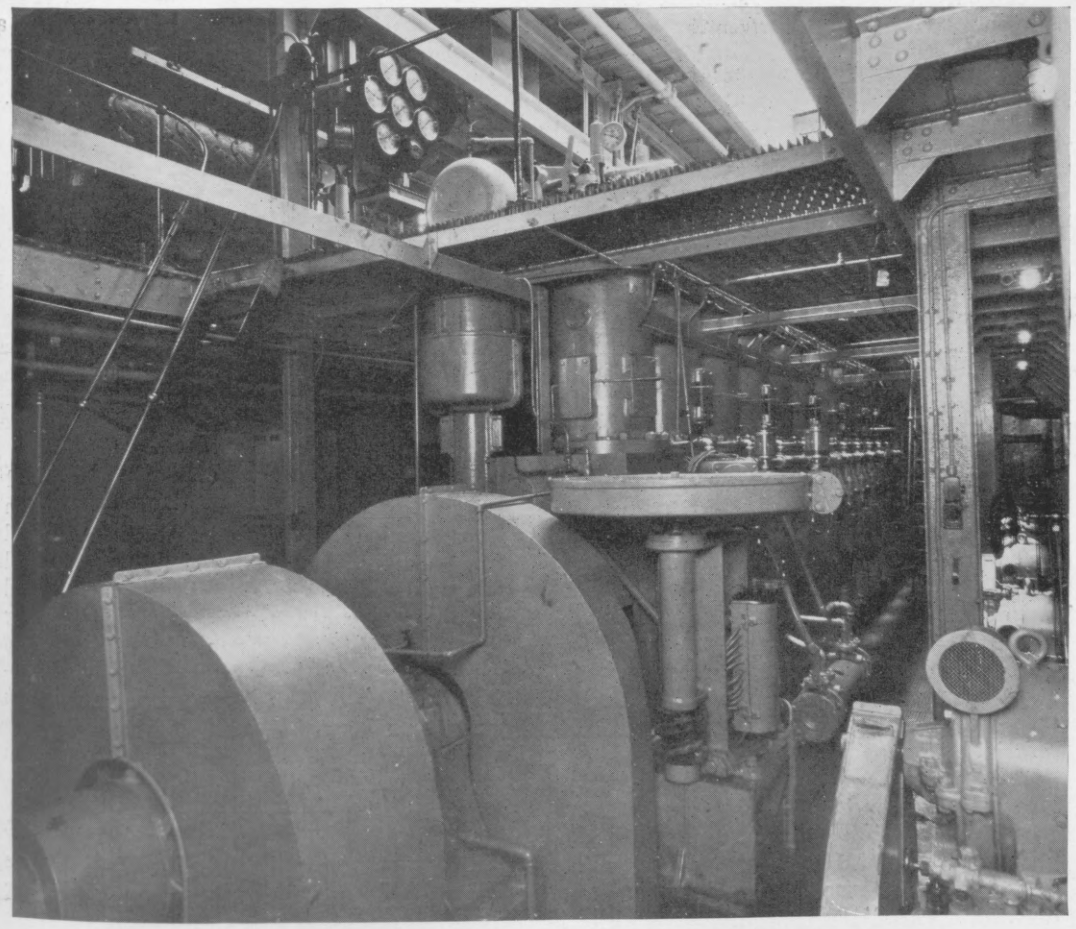


Dredge pump engine has its controls on the main deck at its forward end

the engines, including pyrometers. The pump is of centrifugal type with a self-aligning roller type bearing at the pump-end of the shaft and a deep groove self-aligning ball type thrust and radial bearing between the pump and the main engine. A flexible coupling fitted between the engine and pump is capable of transmitting 1100 b.hp. at 210 r.p.m.

The suction pipe is arranged on the ladder at the forward end and has an electrically driven cutter superposed above it. This cutter is driven by a 200 hp. motor through spur gearing and operates at from 300 to 450 r. p. m. The motor is ventilated by a special fan, driven by a 2 hp. motor designed to operate at 45 deg. The discharge pipe from the pump is taken along the port side of the ship, across to the center-line at the aft end, thence to discharge through the stern. The pump is rated to deliver 5000 tons of material per hour dealing with mud or sand having 16 per cent of solids.



Dredge pump engine is a direct connected 10-cyl. unit rated at 1100 b.hp.

A 700 gal. per min. vertical rotary sump pump is arranged in the pump chamber. Hull compartments forward of the pump compartment are occupied by fresh water tanks and air spaces.

The house on the main deck has its forward end occupied by the dredge ladder operating winch — a five-drum machine. The two outer drums handle the spuds, raising or lowering as required, the two inner drums operate side tackle for the dredge arm while the centre drum raises and lowers the ladder itself. The ends of the winch have drums attached which are intended for warping purposes. Each drum is controlled by a special clutch from the pilot house and can be operated individually. The whole unit is driven through gearing by a 125 hp. electric motor operating normally at 600 r.p.m. Workshop tools are arranged around the side of the deckhouse abaft the windlass and these comprise a lathe, emery grinder, drill grinder, and drill. Then on the port side is a 1-ton refrigerating machine, a store room, a laundry, a coal bunker and a coal fired donkey boiler and two lubricating oil purifiers. For all the lubricating oil used on board there is a tank with a capacity of 1200 gal. For the clean oil there is another tank of 400 gal. capacity and in the engineroom there is a service tank of 100 gal. capacity, in addition to three auxiliary tanks. Connected with this system are two motor driven oil purifiers of centrifugal type.

In the fuel oil system no provision is made for centrifuging, but fuel oil heaters are installed. These heaters have a capacity for heating 600 gal. of 16 deg. Beaumé oil from 60 deg. Fahr. to 110 deg. Fahr. in one hour when supplied with steam at a pressure of 15 lb. per sq. in.

Abaft the machine shop on the starboard side is an 85 kw. Diesel generator, the operating unit being a 4-cylinder 120 hp. Worthington engine. This set is used for auxiliary purposes. The ship's main switchboard is situated on this side also and it comprises generator and feeder panels complete with instruments, including curve drawing ammeter, watt-hour meters, shunts, ground detectors, circuit breakers, rheostat control switches, etc. There is also a voltage regulator for the large motor generator set.

Aft of the switchboard is an exhaust gas boiler which supplies steam for ship heating and distilling. This is operated by the exhaust from the two main generator engines. A boiler feed pump and a hot well pump are abaft this again and here is also a small 10 kw. emergency generator set. The big motor generator set for booster pump work is located in a cage compartment at the aft end of the main deck house. There are also two small 6 kw. motor generator sets for transforming current from 230 volts to 115 volts for lighting purposes.

RAYMOND will operate normally about 16 hrs. per day and often in locations which are not readily accessible from the shore. Consequently the crew will live on board and complete quarters are provided for as many as 65 to 70 men on the upper deck. These quarters are well fitted and spacious and will take care of a chief engineer, two assistants, four oilers and four wipers, a captain and two mates, and two dredge

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runners, the deck and pipe line crew, steward, three cooks, mess boys, blacksmith, machinist and two electricians.

Dredging operations are controlled from an operating house at the forward end of the hurricane deck. Here are located the clutch controls for the windlass gear and the spud controls, the winch motor controller, cutter motor controller, telegraph to the dredge pump engine—controls for this engine are situated at main deck level—pressure and vacuum recorders for the dredge pump and tachometer. Two 22 ft. lifeboats and a small workboat are also located on the hurricane deck.

Details of Principal Machinery Equipment of Pipeline Dredge Raymond 235 ft. o.a., 5000 Tons Per Hour Capacity

ITEM NO.	NAME	MAKE	QUANTITY	CHARACTERISTICS
1	Dredge engine	McIntosh & Seymour	1	10-cyl., air injection, 4-cycle, single acting, 1100 b.hp., 210 r.p.m. Coupled to dredge pump by Nutall flexible coupling.
2	Dredge pump	Newport News	1	20 in., 5000 tons per hr. capacity.
3	Generator engines	McIntosh & Seymour	2	8-cyl., air injection, 4-cycle, single acting, 850 b.hp., 200 r.p.m. Each coupled to one main generator.
4	Main generator sets	General Electric	2	585 kw., direct current, 230 volt, 220 r.p.m. Each attached to one engine.
5	Motor generator	General Electric	1	800 kw., 230 volt d.c., 720 r.p.m., 1150 hp. Supplies power to booster plant at end of shore line.
6	Auxiliary generator	G. E. C.-Worthington	1	85 kw., direct current, 230 volt, 375 r.p.m., 10½ in. x 10½ in., 4-cyl., 120 hp. engine.
7	Emergency generator	G. E. C.-Hill	1	10 kw., direct current, 230 volt, 3-cyl., 18 hp. engine.
8	Motor generators	General Electric	2	6 kw., direct current, 230-115 volt, for ship's lighting.
9	Switchboard	General Electric	1	Has generator and feeder panels.
10	Searchlight	General Electric	1	18 in.
11	Lub. oil transfer pump	Northern	2	110-228 g.p.m.
12	Distillate transfer pump	Northern	1	50 g.p.m.
13	O.F. transfer pump	Northern	2	50-100 g.p.m.
14	Bilge pump	Worthington	1	Horizontal duplex, 8 in. x 6 in., 300 g.p.m. G. E. motor.
15	Fw. pump	Worthington	1	Horizontal duplex, 4 in. x 6 in., 75 g.p.m. G. E. motor.
16	Sanitary pump	Worthington	1	Horizontal duplex, 4 in. x 6 in., 75 g.p.m. G. E. motor.
17	Cooling water pumps		2	Single stage, 8 in., 600-1200 g.p.m.
18	General service pump	Worthington	1	2 stage, 2 in., 65-125 g.p.m.
19	Fire pump	Worthington	1	2 stage, 4 in., 500 g.p.m.
20	Lub. oil cooler	Schutte & Koertig	1	
21	Oil separator	De Laval	2	For lubricating oil, 350 g.p.h. each.
22	Sump pump	Davidson	1	Vertical, rotary, 700 g.p.m.
23	Ice machine	Remington	1	1 ton.
24	Primer for dredge pump	Schutte & Koertig	1	Water jet, to prime in 2 min. with water at 100 lb. per sq. in.
25	Exhaust gas boiler	Davis	1	Operated from two main generator engines, 750 lb. steam per hr., 50 lb. per sq. in.
26	Boiler feed pump	Worthington	1	Vertical simplex.
27	Donkey boiler		1	Coal fired.
28	Cutter motor	General Electric	1	200 hp., 230 volt, 300-450 r.p.m.
29	Cutter motor fan	Sturtevant	1	To operate at 45 deg. Driven by 2 hp. G. E. motor.
30	Cutter shaft bearings	Cutless	5	9 in. x 14 in.
31	Aux. air compressor	Ingersoll-Rand	1	Vertical, water cooled, motor driven, 97 cu. ft. piston displacement, starting pressure 90 lb., final pressure 110 lb.
32	Aux. emergency compressor	Rix	1	21 cu. ft. free air per min., 1000 lb. per sq. in., automatic cut out switch.
32	Electric pyrometers	Brown		
33	Recording tachometers	Bristol		On main switchboard and in pilot house.
34	Distillers	Baeuerle & Morris		
35	Travelling crane	Armington	1	5 ton.
36	Main engine filters	Bowser		
37	Horn	Strombos	1	Quadruplex type.
38	Hoisting windlass	Hyde	1	Five drums, driven through gearing by 125 hp. 600 r.p.m. G. E. C. motor.
39	Pump engine telegraph	Cory	1	
40	Capstans	Hyde	4	Two forward, two aft.
41	Fire system	Lux	1	Two batteries CO_2 cylinders.
42	Flexible coupling	Nutall	1	Between main engine and dredge pump.

Canal Zone Has Largest Electric Tugs

Two 750 s.hp. Vessels Are Constructing to Handle Heavy Work in the Panama Canal

WITH a length overall of 150 ft. and a power at the shaft of 750, two Panama Canal tugs, bids for the machinery of which have now been completed, will be the largest and most powerful Diesel-electric towboats in the world. They will also be the first tugs of this type in operation on the Panama Canal. The hulls are to be constructed by The Panama Canal at its own plant at the Canal Zone, while the contract for supplying the main engines has been given to the Ingersoll-Rand Co., and for the electrical equipment to the General Electric Co. Designed for heavy towing work in general, the two vessels will at first be assigned to definite duties—one for the Pacific Coast for moving large ships in and out of the Canal, and the other for assisting in dredging operations in various parts of the canal.

The layout of machinery will, in general, conform to that of most Diesel-electric tugs operating at the present time and will consist of two 6-cylinder, 480 hp. Diesels direct connected to a 330 kw. main generator and 50 kw. auxiliary generator or exciter running normally at 257 r.p.m. The exciter supplies power for running auxiliaries, for lighting, etc., as well as for excitation of the main generators and propulsion motor. The main motor is a 750 hp. single armature shunt-wound direct current unit running normally at 150 r.p.m. and controlled from the pilot house by the variable voltage method. Auxiliary machinery, which is exceptionally complete, comprises hydro-electric steering gear such as is normal practice on most well-equipped towboats, an emergency air compressor and a powerful single stage centrifugal fire pump. The fuel oil transfer pump is electrically driven and there are two other rotary pumps having a capacity of 250 gal. per min. each.

The length of these two ships—150 ft.—is 28 ft. longer than WICOMICO, at present one of the largest Diesel-electric towboats in operation. The main motor of this latter vessel has a power of 575 s.hp.

AUGUSTUS, 33,000 ton motor passenger liner under construction in Italy for Navigazione Generale Italiana, is due for launching from the Ansaldo Sb. Co.'s plant early in December.

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Engine Exhaust Muffling As An Art

Engineer Has to Place Ear Close to Silencer to Hear If the Main Engine Is Firing Evenly

WALLACE FISHERIES, LTD., of British Columbia are this year trying out the value of an effectively silenced engine exhaust in five new Diesel engined seine boats engaged in herring seining operations on the coast of Vancouver Island.

The principal reason given for requiring silent running in these boats is that they do a good deal of their herring seining at night, cruising at slow speed till the men hear the gentle flipping of the herrings' tails on the surface of the water. When a shoal is located the boat makes a "set", circling the fish with the seine net.

It is said that when the engine has a noisy exhaust the herring shoals may be passed through unnoticed in the dark. It is also claimed by some observers of seining operations that on occasions when a fish carrier with a loud exhaust has visited the boats engaged in seining the fish have disappeared and it has been hardly worth while starting work again till several hours after she left.

These Wallace seine boats are designated W. No. 1 and so on up to W. No. 11. They are of heavy wooden construction planked with fir over steam bent oak frames. Their dimensions are 64 ft. 6 in. overall by 14 ft. beam, and they are equipped with 3 cylinder 75 hp. Atlas-Imperial engines which drive them at about 8½ knots. The pilot house, engine room and crew's quarters are forward—where a raised deck increases the accommodation below—and there is a large fish hold amidships. On the stern is the seine table, with a roller nearly the width of the boat, over which the seine net is run out and hauled in.

The 5 in. Maxim silencers, with which these boats are fitted, are 22 in. diameter by 48 in. long, weighing 440 lb. They are not installed in the stack but in the forward part of the galley which is on deck abaft the pilot house, the exhaust gases from the silencer being carried up into the stack directly above.

Tug Eldoma has effective silencing

So well silenced is the exhaust that the engineer has to place his ear close to the silencer to hear if his engine is firing evenly. Mr. Branchton of the Wallace Fisheries says that these silencers are working very effectively.

In addition to their value when fishing, silencers are also a help when navigating in foggy weather. The coastwise navigator in British Columbia depends in thick weather very largely on the echo of his whistle thrown back by the bold shores. The fact that sound travels at nearly 1200 ft. per sec. is made use of to estimate the distance from shore. As the sound of the whistle has to travel from the boat to the shore and back again, an echo coming 1 sec. after the sounding of the whistle would indicate that the cliff or hillside from which the echo came was about 600 ft. distant. Of course the hill may not be exactly at the water's edge, and a fairly good knowledge of the general characteristics of the shore is required to navigate safely by the echo. If the shore is very distant or not precipitous the echo may be faint and hard to detect should there be much noise from the exhaust at the time.

Hodder Bros.' tug ELDOMA of Vancouver, B. C., has also put in a Maxim silencer. She is a new boat this year, 65 ft. overall by 15½ ft. beam molded equipped with a 3 cylinder 110 hp. Union Diesel engine. The hull is built of fir with sawn frames. She is operated with a crew of three, mainly on harbor work and on short tows up the coast, handling scows and occasional log booms.

Her 6 in. silencer is 31 in. diameter by 48 in. long and consists of expansion chamber and spiral coils. It weighs 850 lbs. Mr. Hodder, who is engineer, states the exhaust is so quiet that he has to go out on deck near the funnel to hear it at all. He says they had a very noisy exhaust in a previous boat HUSTLER, with a 100 hp. gas engine, and decided to have their next engine well silenced.

Silence is also very useful at times in narrow waters, when passing another boat with a barge or scow in tow that cannot be seen. The hull of the scow often returns a faint but perceptable echo from a whistle, thus indicating its position, when otherwise in a fog there is no other means of knowing how far behind the towboat it may be. The same whistle signal is given by a tug with her tow alongside on a tow line.

Any device which effectively reduces the danger due to navigation in foggy weather is well worth the expense of installation.

New Railroad Tugs Are Diesel-Electric

New York Central Trying Out This System of Propulsion for Its Two Newest Ships

NEW York Central Railroad will shortly place on service its third and fourth Diesel towboats, and their advent will mark another step forward in the Dieselization programme contemplated by this company. The two new vessels, the first of which was launched in September at the plant of the Staten Id. Sb. Co., will have Diesel-electric drive, and since two towboats at present in its service have Diesel mechanical drive (i.e. thero-mechanical reduction gearing) a comparison will be possible between the respective merits of the two types of drive. Furthermore as well as making possible a comparison between the electric and mechanical drive, the fact that an air injection engine has been selected to drive the generators for one vessel while an airless injection engine has been selected for the other indicates that those responsible for future designs wish to have available for future reference the fullest possible data based upon their own particular operating conditions. This same idea was incorporated also in the two present Diesel-driven towboats operated by New York Central.

Characteristics of N. Y. Central Towboats

Length overall	108 ft. 0 in.
Length b.p.	96 ft. 0 in.
Beam molded	26 ft. 0 in.
Depth molded	13 ft. 3 in.
Power	650 s.hp.
R.p.m.	115-145
Number of generators	2

Generator sets are located amidships and the main propulsion motor is aft, direct connected to the propeller shaft. The fuel oil tank is forward. Power for driving the two generators is furnished on each boat by two Diesels, one pair built by Ingersoll-Rand and the other by McIntosh & Seymour. Each engine is a 6-cylinder machine rated at 400 b.hp. The Ingersoll-Rand engine will operate at 265 r.p.m. and the McIntosh & Seymour engine at 300 r.p.m. Each engine is direct connected to a General Electric d.c. generator rated at 270 kw. and 240 volts.

The propelling motor for each boat is a shunt wound, double armature unit, and when connected in series with the two main generators, will be capable of delivering 650 s.hp. to the propeller shaft.

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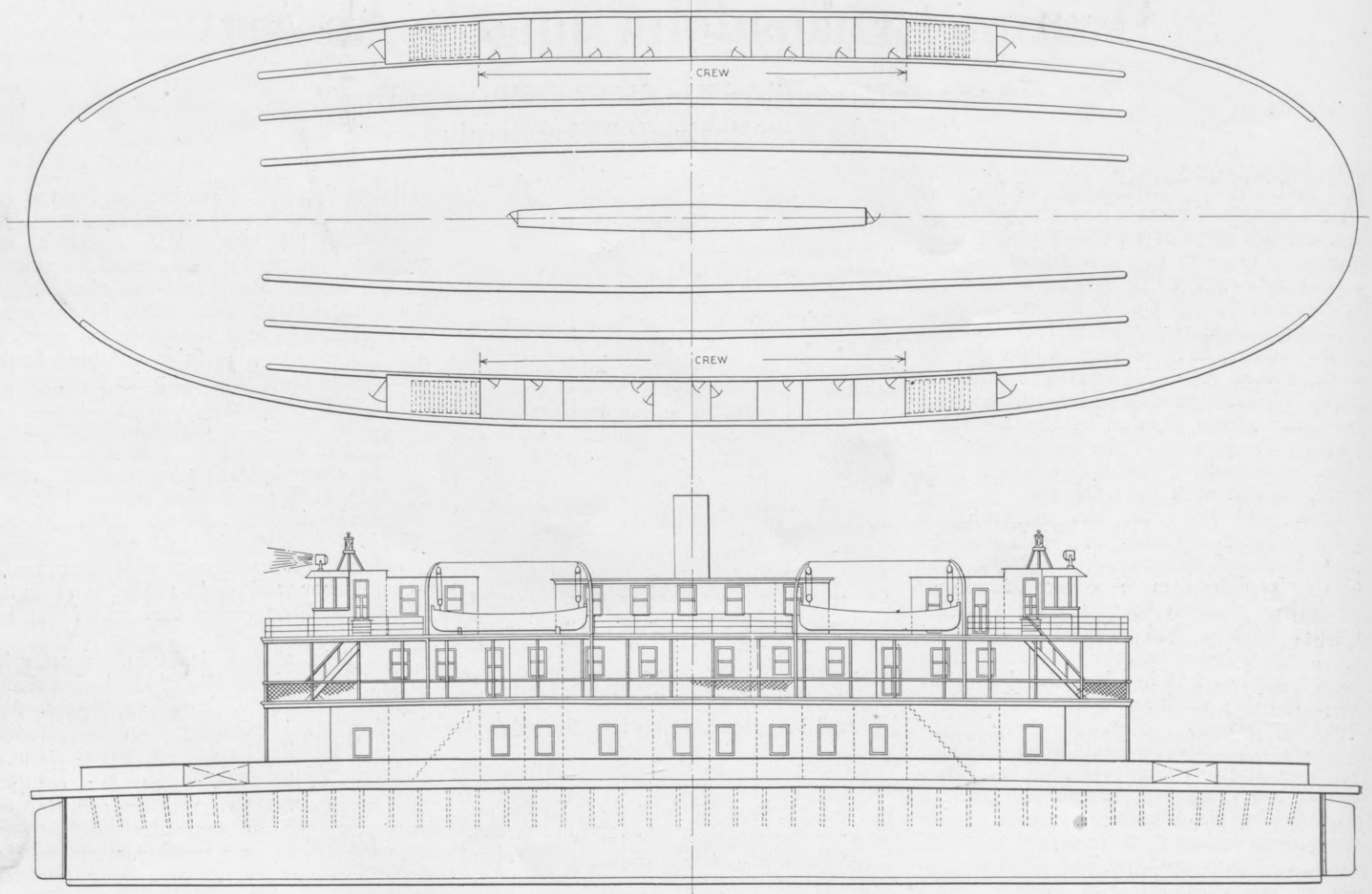
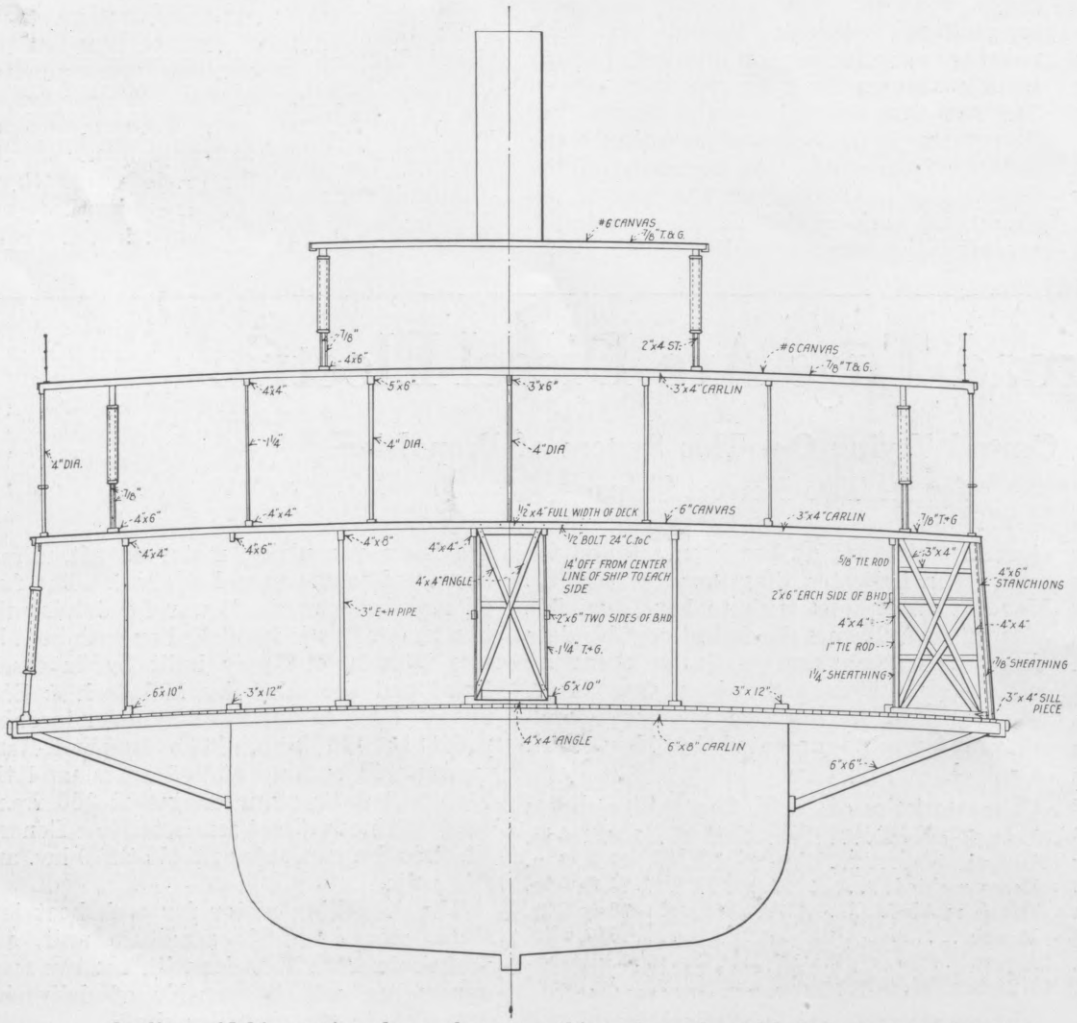


Outboard profile and deck plan of ferry Gov. Albert C. Ritchie give an idea of the ample passenger accommodations and clear auto spaces



Outline midship section shows that everything above the old hull is new construction

MOTOR FERRYBOAT GOV. ALBERT C. RITCHIE HAS BEEN CONVERTED FROM STEAM AND COMPLETELY REBUILT ABOVE THE OLD HULL

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Twin-Screw Double-Ended Ferryboat

Ms. Gov. Albert C. Ritchie, Converted from Steam, Has Four Direct-Connected Diesels of 1440 hp.

INCREASING demand for rapid and economical transportation of automobiles between Annapolis, Md., and Claiborne, Md., resulted in the selection of Diesel engines for the propulsion of GOV. ALBERT C. RITCHIE which, to the best of our knowledge, is one of the very few twin-screw double-ended ferryboats operating in American waters. She is owned by the Claiborne Annapolis Ferry Company, and before her present owners took her over was the side-wheel ferry NEWBURGH, oak-sheathed, steam-propelled, and constructed in the town for which she was named in 1883. Her first owners were the Erie Railroad Co. The extensive alterations necessary to fit the ship for her new work were carried out by the Staten Island Sb. Co., Staten Island, while Diesel engines of 1440 b.hp. for main propulsion and for auxiliary purposes were supplied by Fairbanks, Morse Co., Chicago. Work on the vessel was commenced early in April and completed in July of this year.

Claiborne Annapolis Ferry Co. operates an automobile and passenger ferry service over a distance of about 21 miles between the two points whose names it bears. Before the arrival of GOV. ALBERT C. RITCHIE on service, communication was maintained by two steamers, GOV. EMERSON C. HARRINGTON, a side-wheeler 201 ft. in length b.p., built at Newburgh in 1901, having a capacity for 45 automobiles, and MAJECTIC, a vessel of similar type and dimensions, but smaller power, built at Elizabeth, N. J., in 1903, having a capacity of 30 automobiles. GOV. ALBERT C. RITCHIE, the new Diesel ferryboat, carries 85 automobiles and 1200 passengers in addition.

The tremendous increase in volume of traffic proved the inadequacy of the company's original fleet of two vessels, and early this year it was decided that an extra unit must be added as speedily as possible. Furthermore, it was felt that a vessel of double-ended type would speed up the rate of transportation considerably, because of the facility with which loading and unloading operations can proceed with a ship of this type. Lack of time and impending summer business ruled out new construction entirely, and the directors of the company, therefore, looked around for an existing vessel which, if not directly suitable for their service, could be converted to their requirements in the minimum of time and at the minimum of cost. Diesels were specified for main propulsion, because of their obvious advantage for this type of service in such matters as fuel economy, flexibility, and absence of standby losses.

The vessel finally selected was the side-wheel ferry NEWBURGH, and she was purchased by Emerson C. Harrington, former governor of Maryland and president of the Claiborne Annapolis Ferry Co., from the Staten Island Sb. Co., by whom the ship was owned at the time. She was driven by beam engines of 800 i.hp. operating paddle wheels, and was of the familiar but now rapidly disappearing single roofed type, having one tall stack amidships.

Characteristics of Gov. Albert C. Ritchie

Length, b.p.	193 ft. 6 in.
Beam, molded	36 ft. 0 in.
Depth, molded	13 ft. 3 in.
Height of Saloon Dk. above Main Dk.	14 ft. 0 in.
No. of Driveways	6
Auto capacity	85
Total Power	1440 b.hp.
Service speed	12 kts.

Her steel hull, constructed on the ordinary transverse system of framing with reverse bars along the floor tops, was oak-sheathed and in excellent condition, but so extensive were the alterations that the only part of the old NEWBURGH remaining in ms. GOV. ALBERT C. RITCHIE is the hull and a portion of the deck. Alterations comprised the removal of the complete original superstructure with stack, pilot houses, and the engine casings on the main deck. The old boilers and engines were lifted out, and the old machinery space gutted. A portion of each end of the hull below the waterline was remodelled to take twin screws. In fact, on and in an old hull shell a new vessel was constructed.

Possibly the most noteworthy characteristic of the new ship is the arrangement of machinery. This comprises four Fairbanks, Morse 6-cylinder 360 b.hp. engines, each coupled to a screw, by means of a line of shafting 86 ft. long carried on six spring bearings, through a stuffing box and stern bearing outboard to a strut. Two propellers are at each end of the hull. With the vessel running, all four screws are operating at the same time, the aft propellers pushing and the forward propellers pulling. The two starboard engines are operated as one unit and the two port engines are operated as one unit through a centralized control, which starts, stops, and reverses each member of a particular pair of units simultaneously. In addition, each engine has its individual control system, which gives the further advantage that the pulling engines can be run at a slower rate of revolutions per minute than the pushing engines. This advantage hitherto has only been realizable on ferryboats with electric propulsion. If at any time one of the propellers of GOV. ALBERT C. RITCHIE becomes disabled, or an engine goes out of commission, she can

Ms. Gov. Albert C. Ritchie, a converted single superstructure Hudson River steam ferry, now operating on the Chesapeake

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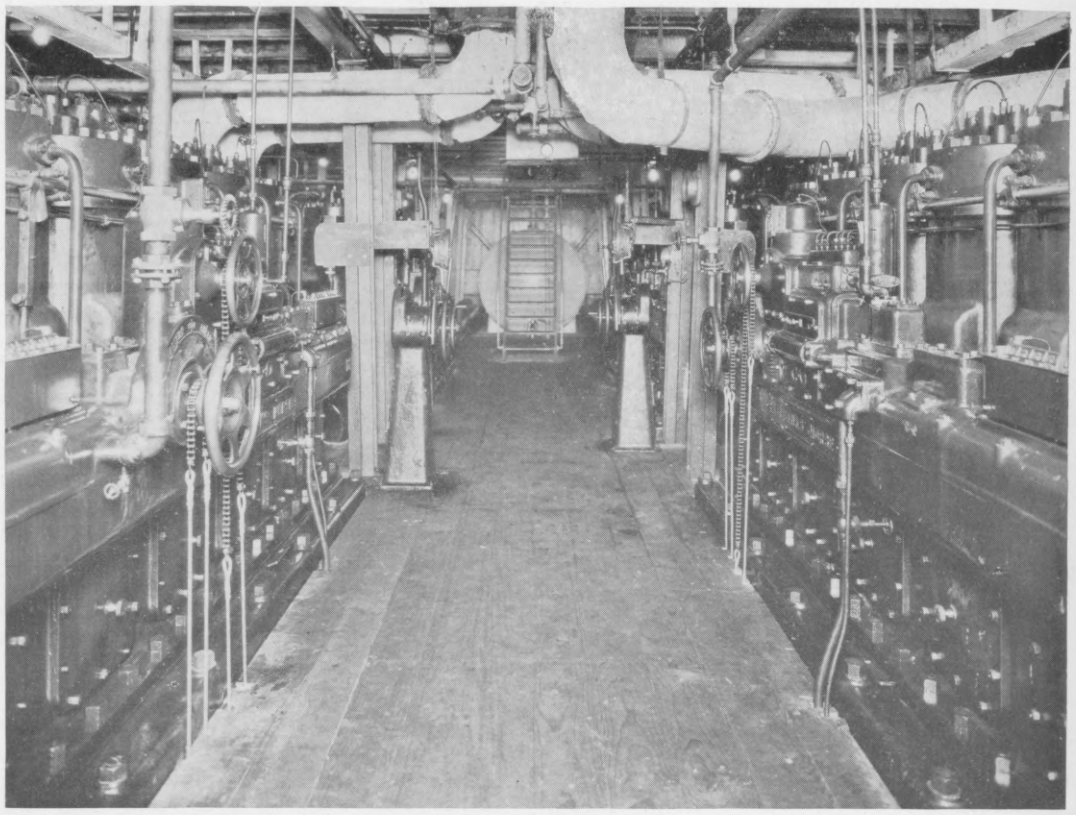
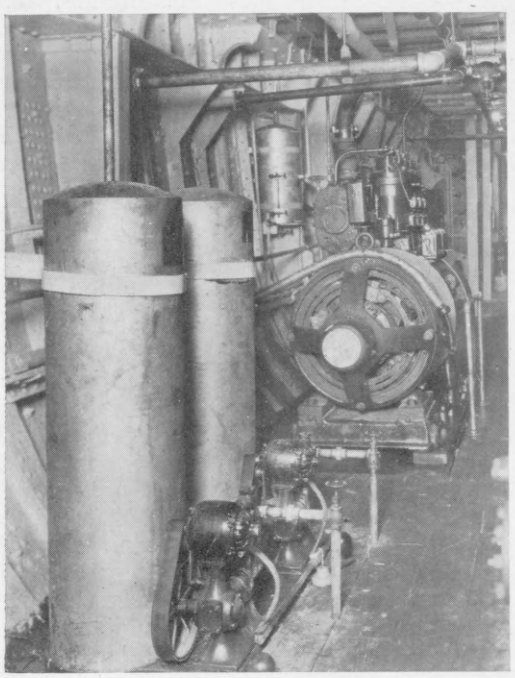
still operate on the other three main units.

The layout of machinery virtually corresponds to two 12-cylinder prime movers coupled up to screws at either end of the vessel in the method adopted in the case of steam ferryboats in which reciprocating engines are installed. Corresponding screws at either end of the boat are opposite turning, so that in maneuvering all that is necessary is to start up the twelve cylinders in the usual manner, with both engines rotating in the same direction. Then afterwards minor adjustments can be made to the speed of each unit as required, by means of the individual controls. The central control is coupled up to the individual controls by means of chains and steel wire ropes. Each engine is direct reversible and there is no flexible clutch arrangement between propeller and prime mover. Perfectly satisfactory maneuvering is carried out by the ship when berthing at either end of the journey by two engineers, one at each pair of engines, and all orders are carried out by telegraph—not bell—orders from the respective pilot houses. Sufficient



Four 360 hp. Diesels coupled in pairs to two shafts have centralized controls



Auxiliary generator set

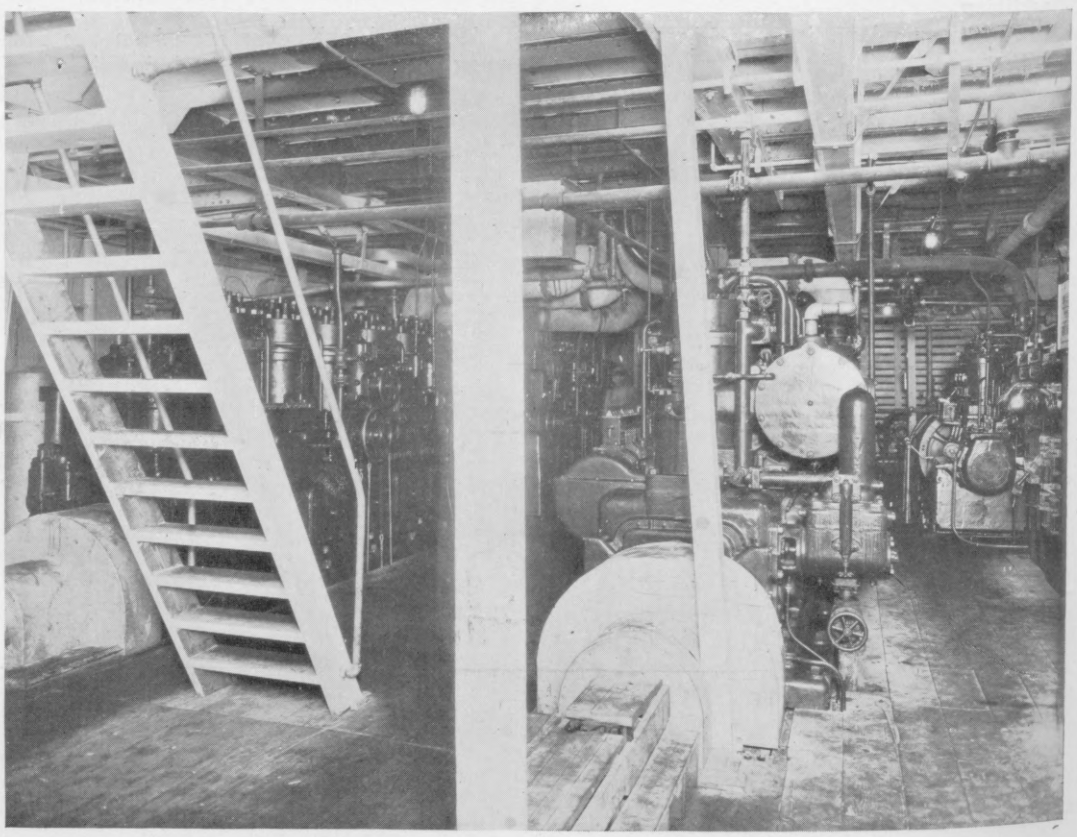
air for maneuvering and for starting, under the most severe conditions likely to obtain in service, is stored in ten 36 in. x 96 in. welded steel storage tanks at 300 lb. per sq. in. pressure. Five tanks are at each end of the ship and located alongside each group is a motor driven 2-stage air compressor.

Exhaust from each of the four main engines and from two auxiliary engines is piped into two 48 in. water bases through which there is a constant supply of water sufficient to carry off any soot or oil which might have a tendency to go up through the stack. The stack is of oval form, 72 in. major axis, about 8 ft. high, and is mounted direct on the two water bases.

The principal reason for the selection of a twin-screw double-ended drive was the desire to compress the 1440 hp. necessary to give ms. GOV. ALBERT C. RITCHIE a service speed of 12 knots into a reasonable space, without absorbing more headroom than that which was available and taking up space on the otherwise clear automobile deck, in the form of casings, NEWBURGH had an i.hp. of 800; the new vessel has practically double this power. It was decided, therefore, to split up the power into four compact units, absorbing a minimum of headroom. This has enabled six driveways to be arranged on the main deck, and the driveway space, with the exception of light pillars arranged between the ways and a small center casing 4 ft. wide, is clear from side to side. The main deck also carries sleeping quarters for the crew, in addition to a galley and mess room.

The engine room is roomy and extends between peak bulkheads. The four main engines occupy the center space, and at either end are arranged a battery of five air storage tanks, one circular fuel tank of 3500 gal. capacity—on the centerline—and one 400 gal. fresh water tank. Two 35 kw. generating sets are fitted in the wings, as well as a fire pump, a bilge and wash deck pump, automatic supply systems for fresh and salt water, and two air compressors complete the auxiliary machinery. Electric steering gear at either end of the ship takes its current from the two generating sets.

The superstructure constructed above the main deck has a height of 14 ft., which gives ample clearance for the largest of trucks. The main superstructure top is



The new machinery layout has resulted in a wide roomy engine space

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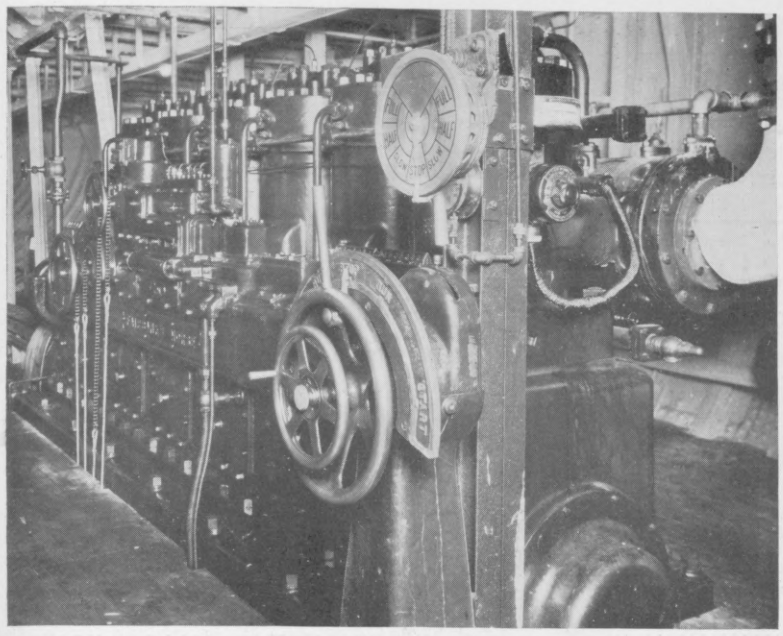
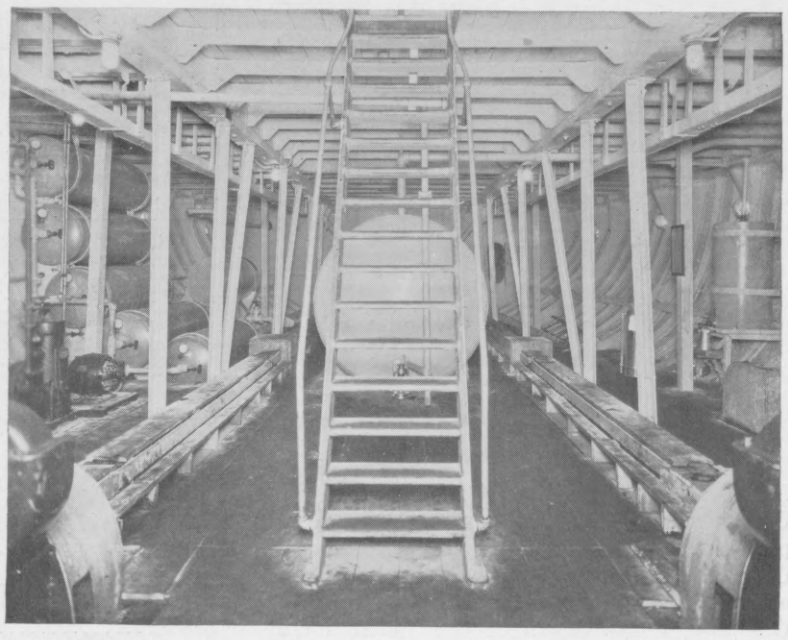


One control operates each pair of main engines



Air storage and a fuel tank are at each end

known as the saloon deck, and a light deck above this again is the hurricane deck.

From the main deck to the saloon deck there are four wide stairways and on the saloon deck there is plenty of space for passengers in good weather, while the saloon itself is commodious and furnished throughout with wicker furniture instead of benches and hard chairs used in many ships of this type.

Opening from the saloon deck are the necessary wash rooms, together with smoking rooms for use in cold weather, and staterooms, one of which is known as the governor's room, and is furnished in most modern style. All the staterooms have metal furniture. A staircase from the saloon leads to a dining room on the hurricane deck. This room is furnished in white and has a hardwood floor. Regulation pilot houses have been furnished. Aft of each pilot house there are two rooms for the officers.

Since delivery GOV. ALBERT C. RITCHIE has been operating continuously between 8 a.m. and 6 p.m. every day. It takes her about 1 hr. 35 min. to make the 21-mile run each way. Her average total fuel oil consumption per hour works out at about 83 gal.

A good test of the vessel's sea keeping qualities was made just prior to going on service, on the passage between the Staten Island yard and Claiborne terminal. She left Staten Island at 6 p.m. on July 12. Pleasant weather was encountered until the next evening when a heavy storm came up and it became necessary to look for harbor. The ship was then 11 miles below the Winter Quarter lightship. Captain Dan Higgins put back to the breakwater at Lewes, Del., and on account of heavy weather the ship was compelled to lay there until July 16 at 10 p. m., when the rest of the run was made without further trouble, arriving at Annapolis July 17, at 10 p.m.

Ms. GOV. ALBERT C. RITCHIE was not built for ocean travel, but she behaved wonderfully in the heavy weather, and the machinery functioned perfectly at all times. All on board during the trip declared themselves highly pleased with the performance of this boat under very trying conditions.

Ferry NEWBURGH had only one light superstructure but Ms. GOV. ALBERT C. RITCHIE has had considerable extra top weight added. It was judged wise therefore to conduct an inclining experiment before the vessel left the Staten Id. yard. This showed that the vessel had an average G M of 8.73 ft., and since the centre of gravity was 12.56 above the bottom of keel the position of the metacentre above the bottom of keel was 21.29 ft. With fuel oil and fresh-water tanks empty the ship had a displacement of 770 tons and a Tons per 1 in. value of 12.58. Further data of the inclining experiment were as follow:—

Inclining Experiment Data

Weights	6010 lb. on each quarter 39 ft. from ends of ship
Inshore pendulum	9 ft. 5 5/16 in.
Outboard pendulum	9 ft. 4⅝ in.
Draft (mean above bottom of keel)	8 ft. 2 in.
C. B. above keel bottom	5.25 ft.
Metacentre above C. B.	16.04 ft.

Details of Principal Machinery of Ferryboat Gov. Albert C. Ritchie, 193 ft. 6 in. b.p., 1440 b.hp.

ITEM NO.	NAME	MAKE	QUANTITY	CHARACTERISTICS
1	Main engines	Fairbanks, Morse	4	6 cyl., single acting, 360 b.hp.
2	Generator engines	Fairbanks, Morse	2	3-cyl., single acting, 45 b.hp.
3	Generators		2	30 kw., direct current, 125 volt, each direct connected to 45 hp. F.M. engine.
4	Fire pump	Fairbanks, Morse	1	Centrifugal, 2 stage, 100 lb. pressure, 30 hp. motor, 100 r.p.m.
5	Bilge and deck pump	Fairbanks, Morse	1	Duplex, 3½ in. x 6 in., 5 hp. motor
6	Compressors	Worthington	2	2-stage, vertical, 5 in. 4¾ in. x 5 in. 10 hp. motor.
7	Automatic water system	Fairbanks, Morse	2	400 g.p.h. capacity, for sanitary system.
8	Automatic water system	Fairbanks, Morse	2	400 g.p.h. capacity for fresh water system.
9	Engine room telegraphs	Chas. Cory	2	Chain type.
10	Steering gear	American Eng. Co.	2	Elect.-hydraulic.
11	Exh. gas pyrometers	Brown	4	
12	Whistle	Strombos	1	Compressed air.

Motorvessels Replace Steamers

Gradual replacement of steam tonnage by motorships is now the definite program of the Rotterdam Lloyd S.S. Co., which operates passenger and freight vessels between Rotterdam and the Dutch East Indies. As soon as the company is in a position to put a new vessel in service, the older steamer is immediately placed on the reserve list and eventually disposed of.

This year the completion of the passenger and mail motorliner INDRAPOERA has brought about the withdrawal of a steamer, KAWI, which is now a relief ship and is only used for occasional voyages when other ships are laid up for repairs. SIBAJAK, a larger motorvessel than INDRAPOERA, is due for service in 1928 and will then replace TABANAN, completed as recently as 1908. This will leave the company with seven passenger and mail ships, the oldest of which is TAMBORA built in 1909.

The two motorvessels INDRAPOERA and SIBAJAK are 15-knot ships with a gross tonnage of 11,000 tons and 13,000 tons respectively. They each have single-acting, 2-cycle engines. Two of the remaining ships are propelled by turbines, and the rest have steam reciprocating engines.

The same replacement program is being adopted in the cargo carrying fleet and steam-driven freighters are sold out of the service as soon as motorfreighters are ready to take their place. Complete modernization of the fleet is aimed at.

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A SUM of $125,000 is planned to be spent by Sound Ferry Lines of Seattle, Wash., on the construction of a Diesel passenger and automobile ferry, to be placed in commission by Apr. 1, 1927. The new ferry will be 176 ft. in length overall, 52 ft. wide, and will have a draft of 12 ft. Space will be provided for 60 automobiles and accommodation for 500 passengers. A 900 hp. Diesel is to give the vessel a service speed of 13 knots.

Maxim Silencer Company, Hartford, Conn., is now occupying new offices in the Capitol Building, 440 Asylum Street.

Four Hundred Voyages

MS. BAYONNE, smallest of the Vacuum Oil Company's fleet of tankers recently completed her 400th voyage between Vacuum Oil Company's refinery at Paulsboro, N. J., and the works at Bayonne, N. J., states *The Compass*, house organ of the Vacuum Oil organization. BAYONNE was completed at Newburgh, N. Y., in August, 1919. During her 400 voyages she has carried in bulk the equivalent of 4,007,100 bbl. of lubricating oil and has covered a distance of 107,000 miles. The vessel has five double cargo tanks and frequently carries as many as eight different grades of oil in one cargo, varying in color from water white to blue.

Furness Sells Surplus Steamers

Four steamers, owned recently by Furness Withy's Prince Line and employed until the advent of new fast motorships on the New York-Far East route, are reported to have been sold recently to German owners, the Hansa Line of Bremen, a large freight ship concern for about $1,175,000, or just over $27 per ton d.w. These vessels, s.s. SLAVIC PRINCE, GOTHIC PRINCE, GAELIC PRINCE and CELTIC PRINCE are all comparatively new steamers of just over 10,000 tons d.w. constructed in 1918 and fitted for oil burning in 1922. They are propelled by triple expansion engines.

AORANGI, big motorliner on the Canadian-Australasian run, is conducting some wireless experiments with special equipment additional to her ordinary wireless telegraph set and direction finding apparatus. Her regular wireless set has an output of 1½ kw. and with it communication has been maintained every night during a voyage with Estevan station on Vancouver Island to positions beyond Auckland, N. Z. A special set, however, has been built on the ship by her own wireless staff for short wave experimental work at distances of 3000 to 12,000 miles. A wave length of 33 to 38 meters is used and with an 800 watt output and 2 kw. input very favorable results are reported as being obtained. Stations in Australia and South Africa have been easily reached from Vancouver, B. C. The experiments are being carried out by A. E. Hay, formerly research engineer with the Radio Communication Co. of London, Eng., who is now in charge of the wireless service of the fleet of the Union S.S. Co.

The two first Diesel electric ferries, for Electric Ferries Inc., which will operate in New York harbor were launched at Camden, N. J. on Oct. 21.

Motorship

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MOTORSHIP is published on the 20th of the month prior to the title month of issue, and all changes and any copy for advertising must be received by the publisher not later than the 5th of the month, if proofs of the copy are desired. Notice of discontinuance of advertising must be given 30 days in advance of publication of the magazine.

Readers are invited by the Editor to submit articles, photographs or drawings relating to motorships, marine oil-engines or auxiliaries. Contributions used in the magazine are paid for on the 15th of the title month of issue, and other contributions are returned as promptly as possible.

MS. KOLSNAREN, 4640 tons d.w. motor freighter, is the first ship to load cargo at Charleston, S. C., direct for Stockholm, Sweden, and Helsingfors, Finland. She arrived at Charleston on Oct. 20th, discharged cargo there and loaded for the above named ports.

U. S. Civil Service Commission announces a competitive examination for the positions of Associate Naval Architect and Assistant Naval Architect with entrance salaries respectively at $3000 and $2400 per annum. The examinations are to fill vacancies in the Bureau of Construction & Repair, Navy Department, and in positions requiring similar qualifications. The duties are to prepare contracts and type plans for new designs and proposed alterations on naval vessels and other similar work. Applications must be on file at Washington, D. C., not later than November 2.

Steamers Increase Freight Rate

The coal strike in Great Britain, coupled with the expensive operation of steam driven freighters has been largely responsible for the 15 per cent increase in ocean freight rates on all commodities controlled by the North Atlantic-United Kingdom Freight Rate Conference. Coal fired steamers operating in the North Atlantic trade since the coal strike have been obliged to bunker on this side of the Atlantic and to carry sufficient fuel for a round trip. This has resulted in a large amount of cargo space being given over to bunkers. The motor freighter can bunker on this side cheaply and quickly and can carry more than sufficient for a round trip across the Atlantic without absorbing any potential cargo carrying space.

REGINOLITE, 9000 ton motor tanker owned by Imerial Oil Company, was the first ship to enter the new 1150 ft. drydock completed recently at Esquimalt, Victoria, B. C. This dock is the second largest in the world, being only 29 ft. shorter than the Commonwealth dock at Boston. It has 40 ft. of water on sills at high water.

MARVOLITE, a 95 ft. steel tanker designed and built for the Imperial Oil Co. by the Burrard Drydock Co. of North Vancouver, B. C., was put into commission this fall. She made a speed of 8.6 knots on her trial run in partly loaded trim. The engine is a 250 hp. Skandia surface ignition engine. This boat is being used for delivering gasoline, lubricating oil and other products of the Imperial Oil refinery at Ioco to ports along the British Columbia Coast.

Okanagan Lake Boat Company is constructing a small motorship 127 ft. in length, with a steel hull, wooden main deck and wooden superstructure. The vessel, which will be propelled by two 6-cylinder Gardner engines, will have a speed loaded of 10½ knots. Accommodation will be provided for 100 passengers and a cargo capacity of approximately four carloads of fruit. The steel work for the hull will be fabricated at Prince Rupert, B. C., and the boat will be constructed at Kelowna.

Borgestad Ltd, of Porsgrund, Norway, will shortly take delivery of another motor freighter of 8200 tons d.w., recently launched at the Gotaverken yard, Gothenburg, Sweden. This vessel will be named BRONNOY and will be practically a duplicate of the BORGESTAD at present owned by the same company. She will be powered by two Gotaverken-B. & W. Diesels of 1400 hp. each at 140 r.p.m., and will have five cargo holds, three forward and two abaft the machinery space. Gotaverken, who constructed ms. BRONNOY, have laid the keel of a sister vessel.

Tank Ships and Panama Canal

During the fiscal year 1924 receipts of tolls from tank ships, states the *Panama Canal Record*, aggregated $9,071,835 and comprised slightly more than 37 per cent of the total revenue collected in tolls from vessels transiting the Canal. In 1925 the volume of tanker tonnage passing through the Canal declined appreciably, and the revenue from tolls dropped to $5,728,362, comprising slightly less than 27 per cent of the total revenue collected for tolls during that year. During the year ended June 30, 1926, tolls from tanker tonnage aggregated $5,626,167, and comprised 24½ per cent of the total revenue collected as tolls.

The volume of general traffic has been increasing from year to year, but for the year 1925, the small increase in general cargo tonnage was insufficient to offset the marked decrease in tanker tonnage and, consequently, tolls for the year ended June 30, 1925, were nearly $3,000,000 lower than for the preceding year. During the past fiscal year tolls levied on general cargo carriers were greater by more than $1,600,000 than in the fiscal year 1925, and with the tanker tonnage remaining approximately the same, the result was an increase of more than $1,500,000 revenue collected.

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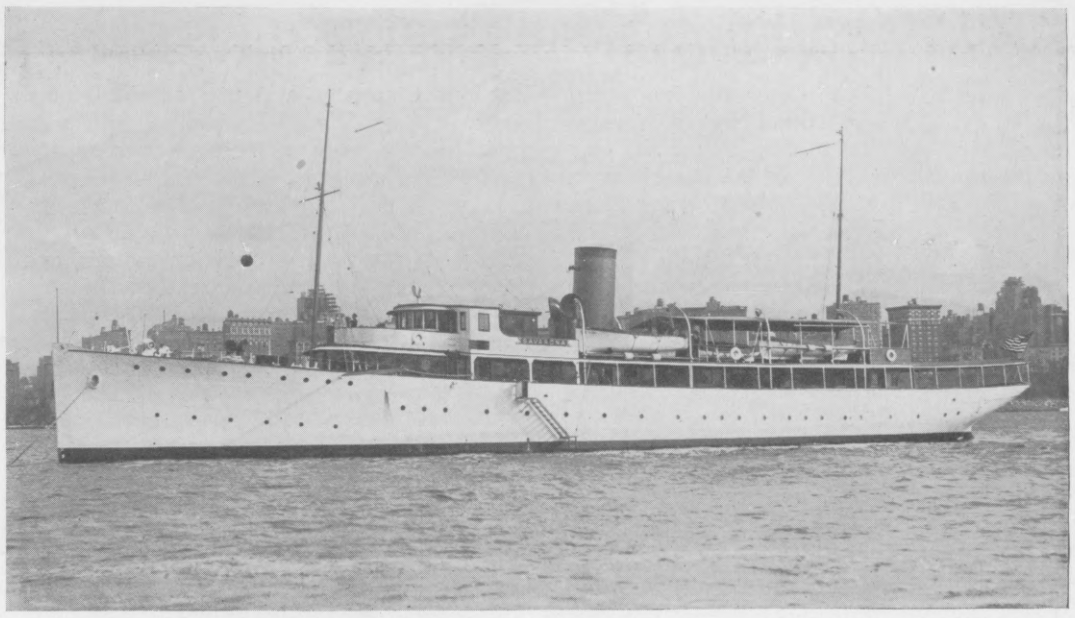
Motoryacht Savarona

SAVARONA, 186 ft. motoryacht recently delivered to R. M. Cadwalader, Jr. of Philadelphia by the Newport News yard, is one of the latest Cox & Stevens designed vessels to go into service. She is powered by two 800 hp. Winton Diesels and her engineroom layout is in practically all respects similar to that of ARCADIA, 188 ft. motoryacht built for Galen L. Stone of Boston, described briefly in the October issue of MOTORSHIP. SAVARONA, like ARCADIA is a speedy vessel, reached over 16 knots on trial and will have a service speed of about 14½ knots. Like ARCADIA she has a straight stem and counter stern and two slightly raked pole masts.



New motoryacht Savarona is powered by twin Diesels of 1600 hp.

Diesels Satisfactory in Storm

MS. ANSALDO SAN GIORGIO II, an 8000 ton d.w. motor freighter powered with 1250 hp. Fiat Diesels, the license for the manufacture of which in America is held by the Nordberg Co., was caught in the recent hurricane which did so much damage to the Florida coast. For 6 hours the engine was able to move ahead in the storm but afterwards conditions became so violent that waves broke and tore away the lifeboats, engineroom skylights, deck piping, ladders, bridges and other parts. In addition to this damage the rudder was disabled by the controls being torn away. For 30 hours after the rudder was disabled the ship was maneuvered in the best way possible by means of the two engines. During this time a large quantity of water poured in through broken skylights. Even with the bilge pumps working it was impossible to prevent some water being drawn into the air intakes, which resulted in the lubricating oil becoming emulsified. Even when working under these difficulties, the engines performed perfectly and answered every order from the bridge. After the storm had subsided the ship was taken in tow but later when the rudder was repaired she reached port under her own power with cargo safe. A performance such as this certainly speaks well for the sturdiness and maneuvering qualities of the engines.

A contract has been awarded to Burmeister & Wain, Copenhagen, for construction of a motortanker of 12,000 tons d.w. for the Danish Petroleum Company. The price is about $804,000.

On Sept. 1, Burmeister & Wain engines under construction or on order for motorship amounted to 305,035 i.hp. This power was for 79 ships of a total displacement of 747,532 tons.

Great Lakes Tug

WM. A. LYDON is a salvage type tug completed recently for service on the Great Lakes for the Great Lakes Dredge & Dock Company of Chicago. She has an overall length of 180 ft., a beam of 25 ft. and a depth of 4 ft., and is powered by a 750 hp. Fairbanks Morse Diesel, which exhausts into a squat stack abaft the pilot house. A powerful towing machine is arranged aft and there are also two heavy derricks. The vessel has a large cruising radius. Manitowoc Shipbuilding Corp. are the builders.

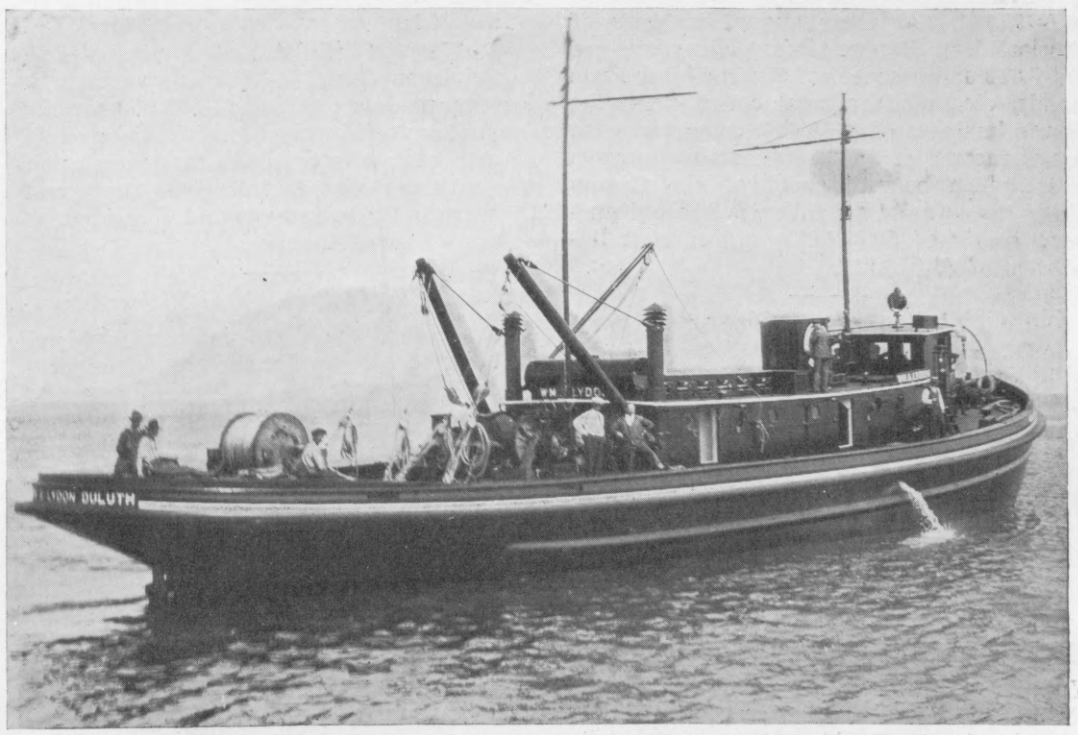
Hydraulic Clutches

Double-acting 4-cycle Beardmore-Tosi Diesels geared to the propeller through Vulcan hydraulic clutches and single reduction gearing, form the present machinery installation of WULSTY CASTLE originally constructed as a turbo-electric ship. She has two 3-cylinder engines of 20⅛ in. cylinder diameter and 24½ in. piston stroke developing a total output of 1700 s.hp. at the high speed of 245 r.p.m. The clutches and reduction gear reduce the engine speed to a normal propeller speed of 80 r.p.m. The engines were built at the Vulcan Works, Hamburg, under license and the ship which has a deadweight capacity of 6300 tons is to be managed by James Chambers & Co. of Liverpool, England.

MODAVIA is the name of a new motorship launched recently for the Donaldson Line's Canadian cattle trade. She is propelled by a Vickers airless injection 4-stroke cycle Diesel developing 2700 b. hp. at 110 r.p.m.

CLAM is the name of a 10,000 ton d.w. motor tanker launched recently from the Netherland Sb. Co.'s yard in Amsterdam for the Anglo-Saxon Petroleum Company. This vessel is being constructed for Anglo-Saxon's big building program and will be fitted with a double-acting 4-cycle Werkspoor Diesel of 3500 hp., which will give the ship a service speed of 13¼ knots. This double-acting engine, which will have a cylinder diameter of 32¼ in. and a stroke of 59 in. has a special director valve. The valves are arranged in a circle providing a symmetrical cylinder head layout.

Anglo-Saxon Petroleum Co. has recently placed an order for the construction of two motor tankers with a French firm. These vessels will have each a deadweight capacity of 9500 tons on a draft of 23 ft. 9 in. and will be powered by two 6-cylinder Werkspoor Diesels developing 2850 b. hp. giving a service speed of 11 knots. The ships will be built with combination longitudinal and transverse framing.



Wm. A. Lydon is a powerful tug recently completed for work on the Great Lakes

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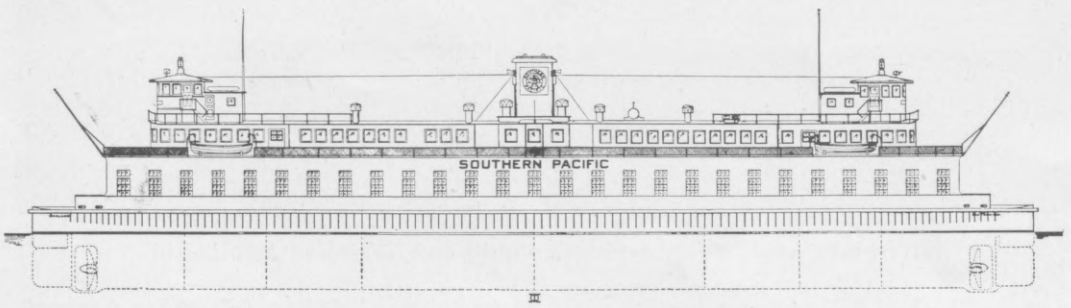
20,700 S.hp. for San Francisco Ferries

CONTRACTS now placed for propelling equipment for Diesel-electric ferries intended to operate on San Francisco Bay involve the construction of 33 Diesels with an aggregate hp. of 13,650, 33 generators and exciters with a total output of 12,660 kw., and 18 propelling motors with a total power 20,700 s.hp. This represents a very valuable piece of business to the Diesel building and to the electric industries and gives an indication of what may be expected in the future when the advantages of Diesel-electric propulsion for ferryboat propulsion are more generally realized. San Francisco is certainly taking the lead in this respect. Southern Pacific Railroad Company, and Golden Gate Ferry Company are the two principal participants in this large order.



Six Diesel ferries of this type are building for Southern Pacific Lines

We announced in our last issue that the Southern Pacific Railroad had decided to construct two Diesel automobile ferries for service on San Francisco Bay either between Sausalito and San Francisco or Oakland Pier and San Francisco. The number of these ferries has now been increased from two to six, and three of the vessels will be built by the Bethlehem Shipbuilding Corporation, one by General Engineering & Drydock Company and two at the Moore Drydock Company. The propelling equipment in each case will comprise four 450 b.hp. Nelseco engines direct connected to a 275 kw., 250 volt generator and a 40 kw., 125 volt exciter. These sets will supply current to two main propulsion motors, one motor being located at each end of the ship and rated for 1250 s.hp. at 130 r.p.m. These motors are to be so arranged that the speed of either may be varied over a wide range, thereby dividing the load between the bow and stern motors at the will of the operator. Variable voltage control will be used, arranged for operation either from the pilot house or from the engine-room. The whole of the electrical equipment for the four boats will be supplied by General Electric Company, while that for the other two vessels will be of Westinghouse type.

The new vessels will be of the double-ended type and will have an overall length of 256 ft. with an auto capacity of 90 and a passenger capacity of 500. Much interest attaches to this contract because Southern Pacific Railroad, which is the owner of a large number of steam driven ferries including one of the largest ferries in the world, has up to this time had no experience with Diesels. Its decision to go in for this up-to-date form of ferryboat propulsion follows closely on the heels of the building of three Diesel-electric ferries for the Golden Gate Ferry Company and the service of the Diesel-electric tankers owned by Standard Oil of California.

Economies effected in the operation of the motorferries GOLDEN GATE and GOLDEN WEST fostered the construction of a third motorferry GOLDEN STATE, which was added recently to the fleet of the Golden Gate Ferry Company. Successful operation of this latter vessel, coupled with increasing traffic demands has now decided this company to construct three further Diesel-electric ferryboats which will be operated between Hyde Street, San Francisco and Berkeley, Cal.

Electrical equipment for each of these vessels will be of Westinghouse type and comprises three 270 kw., 250 volt generators and 30 kw., 115 volt exciters coupled to Diesel engines operating at 265 r.p.m. These will supply current for operating two 950 s.hp., 750 volt propelling motors operating at 180 r.p.m. Pilot house control is arranged. The vessels will be of double-ended type and with the vessel traveling in any one direction the motor at the forward end will simply turn over at such a speed that the propeller will impose no resistance to the forward movement of the vessel through the water. When traveling in the opposite direction the motor, which had been the aft motor becomes the leading motor and control is so arranged that the speed of this motor is automatically reduced to the proper rate while the speed of the other motor is increased to its full 950 s.hp. value.

The Diesels driving the main generators are of Ingersoll-Rand type.

Financial Notes

Wm. Cramp & Sons

CRAMPS reported an operating loss of $74,634 at their annual meeting of stockholders. Depreciation allowance of $477,080 and payment of $84,754 interest on bonds, etc., made a total deficit from the year's business of $636,459, compared with a net income of $563,386 for the previous year. The balance sheet of the Cramp Company and its subsidiaries showed current assets of $6,057,857 and current liabilities of $1,656,218.

Nippon Yusen Kaisha

Nippon Yusen Kaisha made a profit of $1,286,000 for the half year ended March 31 last—a considerable increase over the two previous terms—and the directors voted an 8 per cent dividend. Authority was given to the president by the stockholders to issue debentures within a limit of $14,400,000 to cover the cost of three large passenger motorliners which, as already announced in MOTORSHIP, will be constructed in Japan to offer vigorous competition in transpacific trade. Nippon Yusen Kaisha's absorption of Toyo Kisen Kabushiki Kaisha greatly increased its strength in the Pacific.

Companhia Nac. de Navegacao Cost.

This Brazilian coastwise navigation concern, which owns three passenger and freight motorships and is now constructing eight modern 14½ knot motorships in Europe, made a profit of $1,072,000 for the fiscal year ended June 30. Of this amount 10 per cent was credited to depreciation fund, 10 per cent to insurance fund, and the remainder to reserve and conservation and purchase of tonnage.

Swan, Hunter & Wigham Richardson

Swan, Hunter paid an interim dividend of 3 per cent, less income tax, upon preferred stock and also upon ordinary stock. Last year's interim dividend was 3 per cent free of tax. For the year 1925 the company paid a dividend of 7 per cent free of tax. The ordinary share capital of the company is $8,555,320, and reserves amount to $6,450,000. Commenting on the financial situation of the company, our London contemporary *Fairplay* remarks that, in view of the keen depression in the shipbuilding trades, stockholders are to be congratulated on receiving any dividend at all.

This company has recently constructed several Canal type freighters for Canada.

American Capital in Europe

Amounts of American money aggregating over $365,000,000 have recently been invested in European industrial and transportation concerns. The list includes large works such as the Thyssen concern, with which $12,000,000 has been invested, steamship lines, railroads, and a well known Diesel engine building concern. This company—The Fiat Co.—has absorbed $10,000,000 of the total and is shortly to commence work on the sixteen 10-cylinder units aggregating 84,000 hp. for the two "motor Mauretanias" building for the Cosulich Line's Trieste-New York service.

EUROPEAN INVESTMENTS

CORPORATION	INVESTMENT
August Thyssen Iron & Steel Works	$12,000,000
Cunard Steamship Co., Ltd., Great Britain	7,500,000
French National Mail S.S. Line	10,000,000
Fried Krupp, Ltd	10,000,000
General Electric Co., Germany	30,000,000
Hamburg-American Line	6,500,000
Holland-American Line	7,360,000
Alpine Montan Steel Corp., Austria	10,000,000
Framerican Industrial Corp.	12,000,000
Italian Submarine Cable Co.	8,557,000
Mercurbank, Austria (stock)	1,500,000
United Steamship Co., Ltd	5,000,000
Fiat Stabilimento Technico Triestino (Italy)	10,000,000

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Motorships' Machinery and Operation

All Latest Knowledge of the Art and Most Recent Practices Recorded in Handy Form

EVERY owner, every operator, every marine superintendent, every engineer—chief and assistant too—finds himself faced from time to time with problems falling outside his own immediate knowledge or experience. The clever one is he who knows where to turn for a solution.

No man carries within his own mind the answer to every problem he has to solve. The junior turns to his chief; the chief turns to his boss; the boss often turns to a consultant. Somewhere in this complicated modern organization of our business world you can find the answer to your problem—not always where you expect to find it, and sometimes only after a long search.

Many a man accepts too readily the proffered opinion of one who is supposed to know but does not really know. Many an undertaking is unwisely started on bad advice and continued on the same basis. Every profession is crowded with incompetents, who yet make a living. Even the biggest financial institutions burn their fingers through placing reliance on advice that seems sound but would prove unsound if investigated.

In matters affecting motorships erroneous opinions are frequently expressed, both for and against. The errors are seldom deliberate, but often the outcome of loose thinking and negligent phrasing. Numerous problems are predicated on false premises; how then can a correct answer be given?

If you find a man delimiting the boundary of his remarks you can be reasonably sure that he knows his subject thoroughly and expresses his opinions not only carefully but also clearly. For instance, what could be more reassuring of a man's ability and competence to discuss his subject than an introduction like the following, wherein the limitations are clearly defined?

"Study of numerous comparisons of motorships and steamships leads to the conclusion that generalization is permissible only to a limited extent in such comparisons. The factors that influence the determination of the characteristics of a vessel for some particular service are highly variable, and it not infrequently happens that apparently identical conditions are in reality dissimilar, due to the influence of special circumstances that have no relation to the inherent characteristics of the type of motive power under consideration.

"For this reason the only rational basis for comparison of motor and steam vessels is the particular service in which they are to be employed, with due consideration to all the limiting factors that may exist, not forgetting, however, that conclusions once reached must be subject to possible future modification in the light of new developments."

That is the manner in which Louis R. Ford begins his chapter on the "Superiority of Motorships," which he has contributed to the 4th Edition of the MOTORSHIP Yearbook just published. You know at once that Mr. Ford is dissecting the subject in an able and painstaking manner, with a full consciousness of the need for indicating to his readers that the individual circumstances must aways rule the final considerations.

Louis R. Ford has given to American engineering literature in "Practical Marine Diesel Engineering," one of the best books yet written in this country about Diesel engines. He is consulting engineer to the Morse Dry Dock and Repair Co. and Associate in Mechanical Engineering at Columbia University, and has a long record of experience in submarine Diesel engine work and in merchant marine installations.

What Ford has written for the new MOTORSHIP Yearbook is different to what he published in his own book. He treats here, for instance, "Progress in Engine Design" and "Types of Marine Oil Engines," including a very interesting comparison, on facing pages, of the cross-sections of the four styles of double-acting Diesel engines that are already being installed in many ships.

His observations on "Instruments Aid Operation" will prove most illuminating to owner and engineer alike.

"During the earlier development period," he states, "it was a generally accepted idea that the motorship engineer was adequately fulfilling his mission if he kept the thing running, and such things as measuring and recording instruments were considered laboratory or test stand equipment, entirely out of place in a busy engine room. The engineer's requirements as to means of test and observation were met by feeling or smell or bearings, appearance of exhaust issuing from exhaust pipe, appearance of gas blast issuing from test cocks on cylinders, reading of gages, etc." He then discusses modern practice.

Motorships are considered in a careful analysis outlined by A. C. Hardy, B. Sc. A.M.I.M.E., acting Editor of MOTORSHIP and author of "Motorships." "Merchant Ship Types," "Bulk Cargoes" and "From Slip to Sea," four widely read books published here and abroad. In the chapter entitled "Motorvessels of all Types" reference is made to—and illustrations are given of—all the many different classes of boats in which the advantages of the Diesel engine have been proved. A discussion of the direct drive, electric drive, geared drive and hydraulic drive summarizes the latest practices in the transmission of power from the engine to the propeller.

Engineers will seek elsewhere without avail for such useful sections as they will find in the year book on "Types of Cooling Systems," "Supercharging for Engines," "Oiling of Diesel Engines," "Centrifuging Engine Oils" and notably a very carefully compiled guide to "Construction & Operation," which has been brought right up-to-date, with its references to double-acting engines and supercharging. All the condensed wisdom of many engineers is contained in the latter chapter, which has always been a feature of the earlier editions. An excellent addition to the new Yearbook is an examination paper of the Steamboat Inspection Service, containing some trick questions which the most experienced engineer would have to consider carefully before answering. On the Diesel engineering end the book is very complete.

Under "Improved Bridge Equipment," "Electric Deck Auxiliaries" and "Fire Extinguishing Systems," the Yearbook summarizes the great advances in hull equipment which have been sponsored by the progressive shipowners who have raised the motorship to its outstanding importance today. The radio direction finder, which of course earns mention under the first head, is further elevated in importance by an imposing list of the radio beacons of the world, the latest aid to navigation.

That list is primarily valuable for the shipmaster, but it demonstrates also to the marine superintendent and owner that the r.d.f. is rapidly attaining a first-rank importance. For the use of the shipmaster the new Yearbook contains also a revised list of bunkering ports where boats can obtain Diesel oil or heavy fuel oil.

Information on oil is quite extensive in this book. The specifications on which the Government buys various grades of fuel oil are given. There is a chart for the conversion of viscosities from one scale to another. The new A.P.I. table of degrees gravity—which supersedes the old Beaumé scale, now destined to fall into disuse—appears for the first time, with the equivalents of lb. per gal., kg. per gal., lb. per cu. ft., etc. How the new scale differs from the old can be understood by the statement that 1000 tons of 42 deg. A.P.I. contains 3 bbl. more than 1000 tons of 24 deg. Beaumé.

In the section of handy tables appear the equivalents of inches in meters, the equivalents of feet in meters (from 1 ft. to 750 ft. by steps of 1 ft.) speed and distance table (knots, miles per day and miles per week), Beaufort scale of wind, force, etc.

Over 120 pages of new and instructive information are contained in the front part of the book. The American Bureau Rules and Lloyd's Rules have been omitted for the first time, these rules now being so well known that a copy of them is in the possession of everyone concerned in them.

In the latter part of the book are listed all the motorships of more than 300 hp. that have been built. Last year's number alone is little short of 200 with an aggregate horsepower reaching nearly to half a million. This MOTORSHIP Yearbook Record is unique and presents a listing that cannot be equalled in any other volume published anywhere in the world. It has become recognized as the world standard.

In its new form the MOTORSHIP Yearbook is a compendium of useful information intended to answer in a broad way every question that can be propounded about motorships and oil engines, and this purpose it seems to accomplish very satisfactorily indeed.

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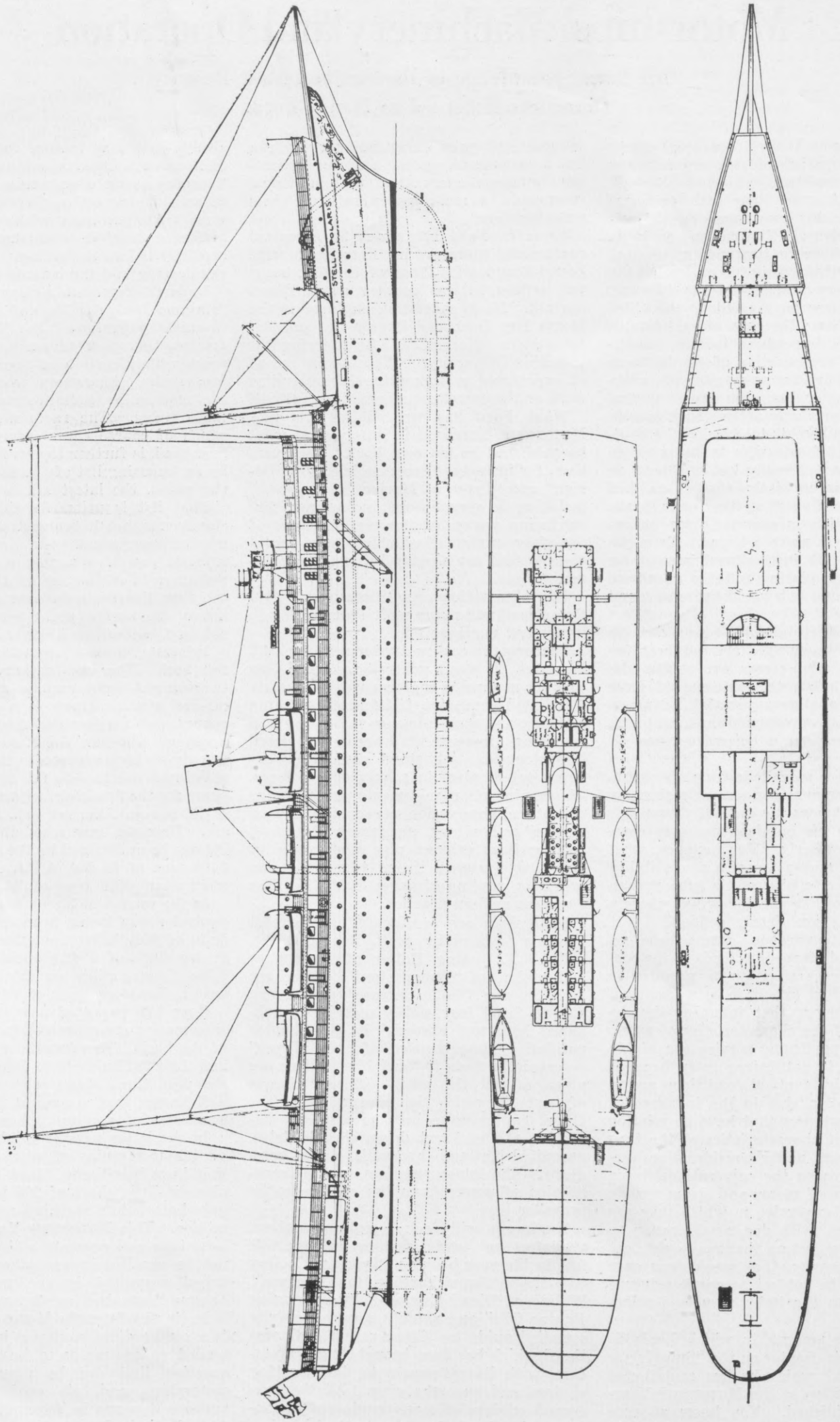
Stella Polaris First Ship Specially Built for Cruising Is Diesel Propelled



From Norway comes the idea that the small specially constructed cruising yacht is economical to operate and easy to run with full bookings. It has remained for the Diesel engine to make worth while the production of ms. Stella Polaris, a 6000 ton ship with two Diesels aggregating 5200 s.hp., designed especially for smooth running

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A New Slant on the Tourist Industry

First Ship Specially Designed for Pleasure Cruising is Diesel Propelled and Has Yacht Lines

FIRST vessel designed and built exclusively for pleasure cruising, STELLA POLARIS, a 6000 ton Gotaverken-built ship, powered with 5000 hp. Diesels, was launched in September, and will be ready to make cruises from European ports to the Mediterranean early next year. The new motor cruising yacht will demonstrate the suitability of the Diesel to yet another type of ship; indeed, it is quite within the bounds of possibility that the fitting of Diesels to this cruising ship may have a considerable bearing upon the future plans of tourist companies and the next few years may see the big shipping and travel corporations operating special cruising motoryachts out of New York on winter schedules to Florida, the Bahamas, and the West Indies, and on summer schedules to Maine and Canadian ports.

Bergenske S.S. Co., Bergen, Norway, which also owns eight freight motorships, is the only shipowning company operating ships of moderate size intended exclusively for the tourist trade and carrying neither cargo nor mails. These vessels are, however, ships converted from other roles. Their cruises embrace the beautiful Norwegian fjords in the Summer months, featuring the land of the "Midnight Sun," and the picturesque Mediterranean in the Winter months, the vessels operating out of Monaco for this latter service. There are at present two ships so employed—one the ex-Kaiser's private yacht METEOR and the other an ex-British Royal yacht now named HELLIG OLAV—both of which are most luxurious vessels with a certain amount of prestige and reflected glory which acts as passenger-getting power, but neither was specifically designed for the work.

All the big passenger liner companies employ or charter certain of their vessels for round-the-world and shorter cruises, many of them operate the Norwegian Fjord cruise from British ports, and others even shorter cruises—such as from New York to the Caribbean.

Large ships of the liner type undoubtedly do work to full capacity on these short cruises, but they are often difficult to handle in small ill-equipped ports. It is questionable too whether it is always the most economical procedure to employ large transatlantic passenger steamers on work of this nature. A moderate sized ship, devoid of cargo space, and fitted exclusively for tourist carrying, is in fact at a considerable advantage on coastwise and short sea cruises. Consequently, STELLA POLARIS is a ship of no small importance, and her owners are to be congratulated in leading the tourist industry by producing a vessel specially for cruising work. Her Diesels will cut the cost of operation considerably, they will add to the comfort of the passengers by eliminating dirt, while bunkering on the cruise will be a thing unknown because sufficient fuel can easily be carried for the round trip.

Model tank experiments were made with different models in the initial stages of the design to determine what was the best hull combining graceful lines with minimum resistance. Passenger accommodation has been laid out with a view to securing the maximum space per individual passenger rather than a maximum number of passengers in the ship. The smaller space occupied by the Diesels has rendered this task much more easy than it would have been in a steamer.

Characteristics of Stella Polaris

Length, overall	428 ft. 0 in.
Length, b.p.	360 ft. 0 in.
Beam, extreme	50 ft. 6 in.
Depth to bridge dack	38 ft. 6 in.
Depth to upper deck	30 ft. 0 in.
Gross tonnage	5200 tons approx.
Displacement	6000 tons
Draft	17 ft. 6 in.
Power	5200 i.hp.
Speed (service)	15 knots

STELLA POLARIS has a graceful clipper bow and long overhang counter; her appearance is further improved by a raking funnel and two pole masts. There are five decks in all, and of these the boat deck or A deck has nine passenger cabins in a deckhouse aft and accommodations for the navigating officers in another deckhouse forward. The promenade deck—B deck—is given over entirely to promenading spaces and public rooms, music room, waiting rooms, entrance hall and verandah café. C deck is the main deck and is the topmost continuous deck of the hull structure. It contains the dining saloon, a wide clear space at the forward end, pantries, staterooms and suites-de-luxe. D deck has more cabins and engineers' accommodation. E deck has more passenger accommodation. Refrigerated space for an extensive series of menus is arranged in the hold. Equipment for taking care of passenger requirements includes also an up-to-date laundry, installed on the main deck, and a well-fitted barber shop. The laundry and the galley and all machinery auxiliary thereto is electric and the only purpose for which steam is used on the ship is for heating. Passenger accommodation is arranged for 200 people and this is split up among four private suites, each containing a sitting room, bedroom and bathroom, 11 staterooms each with two beds and private bathroom, 59 two-berth cabins and 51 single berth cabins. Bathroom accommodation for 20 is also arranged on each deck.

STELLA POLARIS is being constructed to Lloyds highest class and also to the requirements of the Norwegian Veritas. She is powered by two Gotaverken-B. & W. Diesels rated for 5200 i. hp. collectively, which will give the ship a service speed of about 15 knots. All the auxiliary machinery is electrically driven and there are five Diesel generators to supply the necessary current. The Diesel engines for each generator are rated at 180 hp. each.

The attached table, which should be used in conjunction with the map, gives an idea of one of the schedules on which ms. STELLA POLARIS will be employed. It will be seen that the distances and sailing times are such as might easily be arranged in cruises to Alaska, or up the Maine coast and to the St. Lawrence estuary.

A typical Norwegian cruise

Typical Cruise Schedule Ms. Stella Polaris

OUTWARD

	PORT	MILES	DAY AND TIME
Dep.	Newcastle on Tyne	—	Aug. 6, 6 p.m.
Arr.	Bergen	402	Aug. 7, p.m.
Dep.	Bergen	—	Aug. 8, noon
Arr.	Trondhjem	320	Aug. 9, noon
Dep.	Trondhjem	—	Aug. 9, 8 p.m.
Dep.	Svartisen Glacier	267	Aug. 10, p.m.
Arr.	Tromso	259	Aug. 11, noon
Dep.	Tromso	—	Aug. 11, p.m.
Arr.	Hammerfest	120	Aug. 12, a.m.
Dep.	Hammerfest	—	Aug. 12, noon
Arr.	North Cape	58	Aug. 12, p.m.
Dep.	North Cape	—	Aug. 12, 8 p.m.
Pass.	Bear Island	235	Aug. 13, 1 p.m.
Arr.	Spitzerbergen Advent Bay	285	Aug. 14, 9 a.m.

HOMEWARD

	PORT	MILES	DAY AND TIME
Dep.	Spitzbergen	—	Aug. 18, p.m.
Pass.	Bear Island	335	Aug. 19, p.m.
Arr.	Hammerfest	250	Aug. 20, noon
Dep.	Hammerfest	—	Aug. 20, p.m.
Dep.	Troolfjord	264	Aug. 21, noon
Dep.	Digermulen	4	Aug. 21, p.m.
Dep.	Torkhatten	216	Aug. 22, noon
Arr.	Aandalsnes	254	Aug. 23, a.m.
Dep.	Aandalsnes	—	Aug. 23, p.m.
Dep.	Molde	24	Aug. 23, midn.
Arr.	Merok	94	Aug. 24, a.m.
Dep.	Merok	—	Aug. 24, p.m.
Arr.	Gudvangen	238	Aug. 25, a.m.
Dep.	Gudvangen	—	Aug. 25, p.m.
Dep.	Balholm	31	Aug. 25, p.m.
Arr.	Bergen	105	Aug. 26, 6 a.m.
Dep.	Bergen	—	Aug. 26, noon
Arr.	Newcastle on Tyne	402	Aug. 27, 4 p.m.

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Is 42,000 S.hp. the Limiting Figure?

Diesel Powers Now Installed in Passenger Liners Were Considered Unattainable a Few Years Ago

ANY doubt which the more conservative among us may still have harbored as to the applicability of the Diesel engine to the highest powers and speeds likely to be required in mercantile practice has now been dispelled by the announcement that Cosulich line of Trieste are commencing construction of two passenger and mail motor liners of 24 knots speed and 42,000 s.hp. for transatlantic express service.

AORANGI completed early in 1925 for transpacific express service marked the commencement of an era—the era of the large high speed passenger and mail motor liner—and her total power of 13,000 s.hp. and speed of about 16 knots was regarded with doubt or pride, according to the observer's outlook. But in the short period of 20 months this power has been trebled and the speed increased by 8 knots. The same period has seen the advent of a 15,000 s.hp. express passenger liner in the South American trade, of a similar vessel on the Southampton-South African run, and of the pioneer motor passenger liner operating regularly out of New York. These are the "high spots" of a steadily increasing fleet of Diesel engined ships designed for passenger traffic and each representing the last word in ship construction, involving outlays of millions of dollars. Mechanically, economically, and psychologically, therefore, the passenger and mail express motorliner has arrived, but even with the progress made, it would be idle to pretend that finality has been reached, or that we know all there is to know about the best method of distributing the power required to propel the vessel at its required maximum speed. Indeed a review of the machinery layouts of passenger motorliners, both existing and proposed, indicates that no universal opinion exists although there are already several schools of thought on the matter.

Diversities of Opinion

It is, perhaps, significant of this diversity of opinion that the 42,000 s.hp. required for 24 knots service speed for the two "motor Mauretanias" now under construction is to be given by no fewer than eight single-acting units each having 10 cylinders. The required power is thus split up between four shafts, two prime movers in tandem being carried on each shaft coupled either by hydraulic or mechanical coupling. The arrangement is reminiscent of the zenith days of the steam reciprocating engine when tandem coupling was resorted to in order to obtain the required speed. The layout means a total of 80 cylinders, cylinder liners, and sets of valves to be taken care of and requires the provision of a cooling water pump, lubricating oil pumps, and other auxiliaries necessary for their operation. Control, too, is a further important feature where so many units are concerned and in a case like this it is fairly certain that each pair of engines on one shaft will be operated as a single unit with, perhaps, controls at the aft end of each pair at top platform level so that two operators can maneuver the ship. An arrangement of this nature was adopted in the case of four single-acting engines on the AORANGI.

The "motor Mauretanias" have returned, in fact, to the arrangement adopted in the first large passenger and mail motorliner—viz., single-acting 2-cycle Diesels coupled to four lines of shafting. All other liners of over 13,000 s.hp. with two exceptions have double-acting 4-cycle Diesels. Cosulich line have not presumably made their decision without some deliberation and their decision is all the more interesting because they are considerably interested in a well known make of double-acting 4-cycle Diesel which has already proved its worth in vessels now running. Their feeling, rightly or wrongly is that, for the particular layout of passenger spaces they require, it is better to spread the power over a fore and aft space, than to concentrate the floor space and spread upwards with consequent interruption of deck continuity. Which of course, has much to recommend it in a type of ship not requiring a great deal of hold accommodation. The single acting 2-cycle Diesel is excessive in its demands neither on length nor height.

The Excessive Height Bogey

The bogey of excessive height was constantly being brought up in the early days of Dieselizing passenger liners and it was contended that the large double-acting machines, which would inevitably result if big powers were required, would absorb so much head room that the passenger decks would be as badly cut up as they are at present with boiler uptakes. The bogey was proved to be a myth for powers up to about 16,000 s.hp. at which 22,000 ton vessels like the ASTURIAS operate and double-acting engines—of 2-cycle type—aggregating 28,000 s.hp. are now being installed in ms. AUGUSTUS of 33,000 tons gross building for the Navigazione Generale Italiana. This ship will have a four shaft arrangement. The power plant in AUGUSTUS is actually the most powerful yet arranged in a single hull with double-acting engines, and many people thought that it would remain the limiting power for some time. This is probably true as far as double-acting engines are concerned, but there is no reason why the problem should not be tackled from other aspects, which has been done by the Cosulich line in designing its two new ships. They have split up their required power into as many compact units as possible and they have departed from the stereotyped hull form in order to make the most of their power. By the incorporation in the design of a special bow and waterplane section the desired speed is attained with less power than would be required in the case of a stereotyped hull form. It is possible that further developments will take place in both these directions.

Many superintending and operating engineers are rather inclined to look askance at any layout which incorporates a large number of prime movers. The objections are raised mainly on the grounds of excessive maintenance and up-keep and repair charges. This idea may have some justification, but the many advantages should not be lost sight of. It is probably some objection of this nature which has never permitted the only 42,000 s.hp. layout, previous to the Cosulich vessels, to get beyond the paper stage. In this layout 16 prime movers of short stroke high speed trunk piston type were connected—four each—to four shafts through hydraulic couplings.

Following is a table showing the power distribution on recent passenger motorliners building, under construction or projected.

Motorliner Power Distribution

Total Power	Shafts	Prime Movers	Type	Cyls. per Engine
42,000 s.hp.	4	8	S. A. 2-cycle	10
42,000 s.hp.	4	16	S. A. 4-cycle	8
28,000 s.hp.	4	4	D. A. 2-cycle	8
24,000 s.hp.	2	2	D. A. 4-cycle	8
20,000 s.hp.	2	2	D. A. 4-cycle	8
13,750 s.hp.	2	2	D. A. 4-cycle	6
13,500 s.hp.	4	4	Opposed piston	4
13,000 s.hp.	4	4	S. A. 2-cycle	6
7,000 b.hp.	2	2	S. A. 2-cycle	6
6,400 s.hp.	2	4	S. A. 4-cycle	6

Arranged in descending order of powers, it shows clearly the difference in thought existing on the question of powering high power passenger motor liners. The highest powers are given by single-acting layouts and so are the more moderate powers, while intermediate powers come entirely within the realm of the double-acting Diesel. As yet no attempt has been made to fit any large passenger motorship with a Diesel-electric plant in spite of the progress which has been made with this system of propulsion in other directions.

For intermediate powers, there is no question as to the applicability of the Diesel in a wide range of single and double acting engines. At the present time it would seem that the highest powers can only be reached by spreading the power over a number of units, but the rate of development of the last few years leads to the conclusion that in the near future practically the only limitation to Diesel powering will be the maximum size of the ship operable on a particular route.

Economically, the passenger motorliner is proving its superiority in every way over the steamer on account of its lower fuel consumption, ease of bunkering and the other benefits associated with Diesel propulsion in all types of ships.

From the passenger's point of view, the passenger motorliner presents something which is novel and which is the latest thing in ship construction. How the Diesel works or even what the Diesel is does not worry him in the least, but the fact that a large liner is Diesel driven puts a weapon into the hands of the passenger agent.

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List of the Principal Passenger and Mail Motorliners Constructing, Launching, and Recently Placed in Service

NAME	OWNER	POWER	SCREWS	SPEED	DIMENSIONS	TONNAGE	REMARKS
————	Cosulich Line, Trieste	42,000	4	24	715 ft. x 84 ft. x 60 ft.	33,000 G.	Laid down
————	Cosulich Line, Trieste	42,000	4	24	715 ft. x 84 ft. x 60 ft.	33,000 G.	Laid down
AUGUSTUS	Nav. Gen. Italiana	28,000	4	21	706 ft. x 82 ft. 6 in. x 51 ft. 4 in.	33,000 G.	Due for launching
SATURNIA	Cosulich Line, Trieste	24,000	2	18½	631 ft. x 79 ft. 6 in. x 46 ft. 6 in.	23,500 G.	Launched 12-29-25
VULCANIA	Cosulich Line, Trieste	24,000	2	18½	631 ft. x 79 ft. 6 in. x 46 ft. 6 in.	23,500 G.	Due for launching
ASTURIAS	R. M. S. P. Co.	15,000	2	16	630 ft. x 78 ft. x 45 ft.	22,500 G.	Completed maiden voyage 5-6-26
ALCANTARA	R. M. S. P. Co.	15,000	2	16	630 ft. x 78 ft. x 45 ft.	22,500 G.	Fitting out
CARNARVON CASTLE	Union Castle Co.	13,000	2	16	629 ft. x 73 ft. 6 in. x 45 ft. 6 in.	20,000 G.	Now in service
BERMUDA	Furness Withy Co.	13,500	4	16	530 ft. x ——— x ———	———	Due for completion Winter 1927
SIBAJAK	Rotterdam Lloyd	10,200	2	13½	530 ft. x 62 ft. 6 in. x 38 ft.	13,000 G.	Under construction
P. C. HOOFT	Nederland S.S. Co.	10,500	2	15	520 ft. x 67 ft. 9 in. x 48 ft. 6 in.	14,000 G.	Left on maiden voyage 8-31-26
SHROPSHIRE	Bibby Line	8,000	2	15	482 ft. x 60 ft. x 36 ft. 3 in.	10,000 G.	Launched 6-10-26. Scheduled maiden voyage Oct.
CHESHIRE	Bibby Line	8,000	2	15	482 ft. x 60 ft. x 36 ft. 3 in.	10,000 G.	Approaching launching
————	Grace Line	8,000	2	16½	485 ft. x 64 ft. x 36 ft. 6 in.	———	Under construction
————	Grace Line	8,000	2	16½	485 ft. x 64 ft. x 36 ft. 6 in.	———	Under construction
ACCRA	Elder Dempster	7,500	2	14½	468 ft. x 62 ft. x 35 ft.	9,936 G.	Went in service Sept.
STELLA POLARIS	"B. & N." Line, Bergen	5,200	2	15	360 ft. x 50 ft. 6 in. x 30 ft.	6,000 G.	Completing. Cruise yacht

Dimensions are registered dimensions as far as it is possible to check them as such.

proved by the fact that Royal Mail Steam Packet Co. is diverting its 22,500 ton ms. ASTURIAS from its regular Southampton-South American run in order to make a special round Africa cruise to start in New York in January next. The opinion expressed by Sanderson and Son Inc., New York agents for the R.M.S.P. Co. on this matter is illuminating. In a letter addressed to MOTORSHIP published in our August issue they state ". . . . . our new liner ASTURIAS was selected for the Second Great African Cruise primarily on account of the fact that she represented the latest development in marine propulsion . . . . . to give members of the Second Great African the benefit of the best we had."

Furness Withy is next winter modernizing its tourist traffic between New York and Bermuda and will catch much extra traffic, by constructing a 530 ft. passenger motorliner. This ship will cruise to Canadian waters during the summer.

Swedish American Line are also using their GRIPSHOLM for a "cruise supreme" in the Mediterranean early next year—while an enterprising Norwegian company has gone so far as to construct a motoryacht of 5200 i.hp. and 420 ft. in length overall, especially for cruising work in the Norwegian Fjords. For this work the Diesel is particularly suitable. Cruising always involves short bursts of full speed followed by standbys, while passengers are making shore excursions. The psychological appeal holds true not only for cruise passengers but also for the regular passenger trade and here also the passenger agent has a further weapon. The passenger motorliner has much better interior arrangement than the steamer. Clearer deck spaces result because the engine casings can be concentrated in one large unit and do not obtrude in any way in dining saloons or lounges. The absence of hot boiler uptakes, too, will be appreciated by all those who have traveled in inside cabins.

Contemporary with the higher mechanical skill and more thoughtful operation needed with Diesels has come a gradual tendency to improve equipment in all departments. The modern Diesel layout has practically sounded the death knell of steam auxiliaries, while the resultant electricity brings along with it gyro-compasses, automatic steering apparatus, electrical helm indicators, revolution indicators, recording telegraph radio direction finders and other refinements which the progressive shipowner recognizes as a necessity. Navigation is in an evolutionary state and is yearly becoming a more mechanical science. The passenger motorliner represents the latest and best development both on the bridge and in the engine room.

Ten years ago a "motor MAURETANIA" was considered an engineering impossibility. In two years time such ships will be operating regularly out of new York.

Lloyds Class 601,427 Tons in 1925-26

REPORTED activities of Lloyds Register of Shipping for the year 1925-26 show that no fewer than 113 motorships aggregating 601,427 tons gross have been constructed under the supervision of the society. This figure is easily the largest listed in any year and is nearly double the amount of new motorshipping shown last year. In July 1914, 297 motorships with a gross tonnage of 234,287 tons were listed in the Register Book. In July of the present year this number increased to 2343 ships with a total gross tonnage of 3,493,284 tons. Forty-five motorships, each of more than 8000 tons gross were classed with the society at the end of June, 1926, whereas there were only 19 such vessels with an aggregate tonnage of 188,477 tons gross at the corresponding date of the previous year. Of the 45 vessels classified, the two largest are directly concerned with trading to the port of New York, these being the GRIPSHOLM, 17,993 tons gross, engaged in transatlantic passenger trade between New York and Gothenburg, Sweden, and AMERIKALAND, 15,355 tons gross, one of the largest bulk freighters in the world, engaged in the ore trade between Cruz Grande in Chile and either Sparrows Point, Md., or Claremont, N. J. Other large vessels connected directly or indirectly with American shipping are the 11,309 tons tankers CANADOLITE and MONTROLITE; the 9000 tons tanker REGINOLITE; the Standard Oil tankers DEN HAAG, 8971 tons gross and ROTTERDAM, 8968 tons gross; MOTOCARLINE, 8797 tons; and ONTARIOLITE, 8932 tons; the tankers GULFCREST, 8953 tons; CLIO, 8940 tons; and the 8108 ton Italian LEME, which trades regularly from Trieste to Pacific Coast ports.

Twenty-eight sets of double-acting Diesels of 2-cycle and 4-cycle type aggregating approximately 161,000 i.hp. are now being constructed under the superintendence of the Lloyds surveyors.

13,500 Hp. for Bermuda Liner

Special attention is being paid to the elimination of all vibration due to reciprocating parts in BERMUDA, the new motor liner constructing at Belfast for Furness Withy's New York-Bermuda service. Her power plant has been changed from that originally decided upon and will consist of four 4-cylinder Doxford opposed-piston engines designed to develop collectively 13,500 b.hp. at 123 r.p.m., and the ship will thus be the first quadruple screw layout in which opposed piston engines have been used.

A special feature of the engines is that the stroke of the upper piston is reduced while that of the lower is increased in such proportion that complete balance is obtained between the momentum of the reciprocating weights on the lower piston and drive, and the momentum of the reciprocating weights of the upper piston and its drive. The engine is thus free from primary forces and couples. The final balancing between these two drives will be arrived at after the parts have been machined and the weights ascertained, and the final adjustment will be obtained by adapting the thickness of the lower piston skirt. The scavenge pumps are driven off crankshafts placed between cylinders.

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Sketches and Working of Oil Engines*

The Compressed Air Spray as a Means for Supplying Fuel to an Oil Engine

ALTHOUGH apparently less direct than airless injection, primary importance has been achieved by the compressed air method of atomizing fuel into the cylinders of oil engines. Air injection is responsible for the first compression-ignition oil engine ever built, successfully replacing as it did the blundering attempts at solid injection that had gone before. At the present time solid or airless injection systems, generally represented by the types and principles studied in the preceding chapter, appear to have been perfected to a degree fully competitive with air injection, so far as engine cylinders of small and moderate capacity are concerned, whereas for large capacity machines few manufacturers are offering airless injection systems.

On the one hand, it is claimed, air injection produces cleaner and more complete combustion at average cylinder temperatures lower than those found in solid injection machines. On the other hand the argument is advanced that the difference between a good air injection system and a good airless injection arrangement is not sufficient to outweigh what are called the drawbacks and expense of the injection air compressor.

A tendency appears discernible, however, towards the substitution of airless for air injection in machines of smaller capacity, so that it may not be too much to state that the lower limit of engine size at which air injection must yield to the hydraulic spray system appears to be rising.

Attempts to give a more definite report than this about fuel injection systems are baffled by the difficulty of making direct comparisons between air-equipped and airless injection machines. The question at issue resembles the controversy over coffee drinking and long life, partisans on both sides being ready to point at any required number of ninety-year-old persons who have or have not indulged the coffee habit all their lives. It makes the sophisticated observer suspect that there are factors other than coffee which determine the number of years a man shall live, just as there are matters other than air or airless injection which determine the running qualities of an engine.

As stated in the preceding chapter, the fundamental principle of all spray formation depends upon the relative motion between a current of air and particles of liquid being swept along by it. In the airless system the air is largely at rest while the oil particles are projected through it at considerable speed. When the air current is used for injection purposes the situation is reversed, but the method of subdividing the liquid particles is identical in both cases, as illustrated by means of Fig. 3, Chapter II. For a given density of air and relative velocity between it and an oil particle, there is a maximum size of droplet above which its form, as determined by stream-line action and surface tension, is unstable. All drops larger than the "equilibrium drop" are broken down until the surface tension of the resulting smaller drops is sufficient to maintain an integral, approximately stream-line, form. The higher the velocity the smaller is the stable drop size.

Oil issuing from an orifice under hydraulic pressure has its maximum speed close to the exit section, as its velocity is rapidly reduced the further it gets away from the nozzle. Hence it is unlikely that any drops will be formed that are smaller than the smallest one produced near the nozzle exit. Small drops, on the other hand, may coalesce again after traveling some distance from the nozzle, but because of the great reduction in velocity which they have suffered there is little tendency for them to break up again. During their progress against the dense air of the combustion space, their kinetic energy is rapidly spent.

Most of the air jets used for atomizing purposes in oil engines continue to expand and

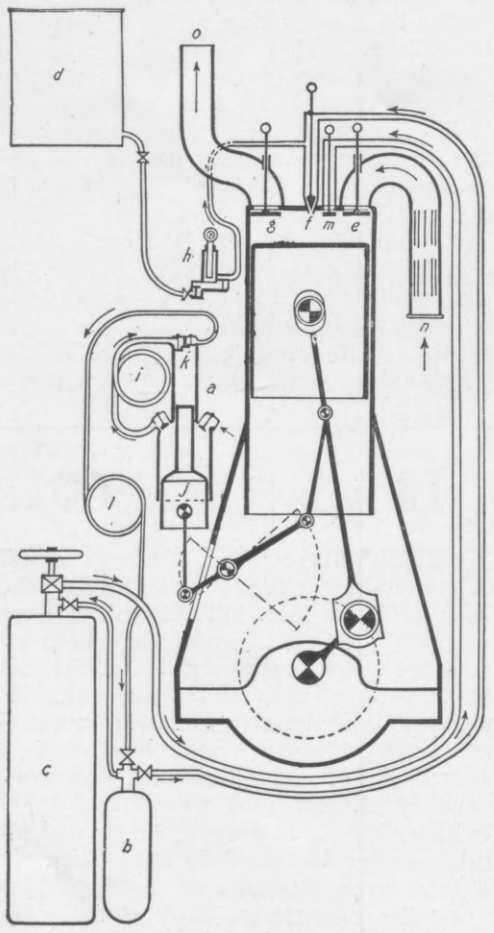

Fig. 14. *Air-injection arrangement*

pick up speed even after leaving the minimum cross section of the nozzle, because air is an elastic fluid. Hence there is a tendency towards a progressive subdivision of the oil particles carried along with the air, corresponding to the increasing velocity. When the air jet has so far spent itself that it causes no further subdivision, it still has energy enough, at least with the general run of well-designed air-spraying nozzles, to creat turbulence in the combustion space, an effect so diligently sought by the designers of airless injection combustion spaces. In the latter arrangements, displacer action by the engine piston and pressure rise due to partial combustion act as more or less perfect substitutes for the whirling and agitation normally accompanying the air injection process.

Although the mechanics of air spray production are difficult to analyze and chart in a scientific way, they seem natural enough to anyone who has ever blown out an oily casting with an air-hose or sprayed perfume with a bulb atomizer. Everday experiences of this kind demonstrate what can be done by way of atomization with the help of an air jet. As far as engine work is concerned, mechanical details are determined largely by five main factors, one of these being that the spray must begin from a mass of liquid oil fuel substantially at rest and under pressure; the second is that it must be accurately timed; the third calls for precise regulation as to quantity; the fourth requirement concerns accurate control of the rate of speed at which oil is fed into the combustion chamber; while the fifth mechanical requisite is a multi-stage compressor, tanks, intercoolers, and accessories suitable for maintaining a compressed air supply at a pressure always greater than the maximum occurring in the combustion spaces of the cylinders.

A general schematic representation of an air injection oil engine is reproduced in Fig. 14, taken from Herbert Haas' excellent work: "The Diesel Engine, Its Fuels and Its Uses." (U. S. Government Bureau of Mines Bulletin 156, Petroleum Technology Paper No. 44.) The method of supplying the mechanically actuated fuel valve *f* with fuel oil from the pump *h* and spray air from the injection bottle *b* are clearly indicated. It is to be noted that the compressed air system includes the compressor *k*, main storage reservoir *c* and the mechanically-operated starting valve *m*, capable of being thrown out of gear as soon as the engine is ready to fire on fuel. Some of the air-piping complication for which this lay-out is sometimes criticized is due to the inclusion of this air starting paraphernalia. However, as only automotive oil engines have hitherto been regularly started by electricity (See OIL ENGINE POWER, July, 1926, page 404), and only one airless injection oil engine installation is known to be arranged for starting on steam (OIL ENGINE POWER, January, 1926), a compressor, piping, tanks, and valves seem to be more or less indispensable, no matter what the fuel injection system may be. For the airless injection method it is claimed as an advantage that the compressor is operated only intermittently to recharge the starting air storage tanks and that pressures of 350 lb. per sq. in. need not be exceeded. (Air-starting systems are fully discussed in another chapter.) An injection air compressor similar to the one indicated in Fig. 14 must operate continuously at pressures above 800 lb. per sq. in. whenever the engine is running at more than half load.

All air-injection systems are substantially similar in having a cam-actuated valve (*f*, Fig. 14; *z* and *d*, Fig. 15) adapted to admit properly timed blasts of compressed air from the tank or "bottle" (*b*, Fig. 14) into the engine cylinder. Somewhere in the compressed air passage, which is controlled by the valve and which leads to a spraying orifice (*t* or *b*, Fig. 15) directed into the cylinder, there is placed a small cavity (*s* and *a*), in which a small charge of oil is lodged before the blast of air sweeps through. The amount of oil varies with the load on the engine, being hand or governor-controlled through some such fuel pump regulating gear as that sketched at *p*. It is important to note that this method of changing the speed and output of the engine is fundamentally different from those employed on gas and steam engines. In the latter the entire charge entering the cylinder is throttled or otherwise regulated as to amount, while the cylinder pressures often vary in response. But the combustion air drawn into an oil engine cylinder is in practically all cases constant, only the oil charge, as mentioned above, and sometimes also the blast of injection air, be-

* Summary of a course of instruction at the Polytechnic Institute, Brooklyn, N. Y., by Julius Kuttner, B. Sc., Licensed Chief Engineer, Associate Editor of MOTORSHIP. This is the Third Chapter of the Series.

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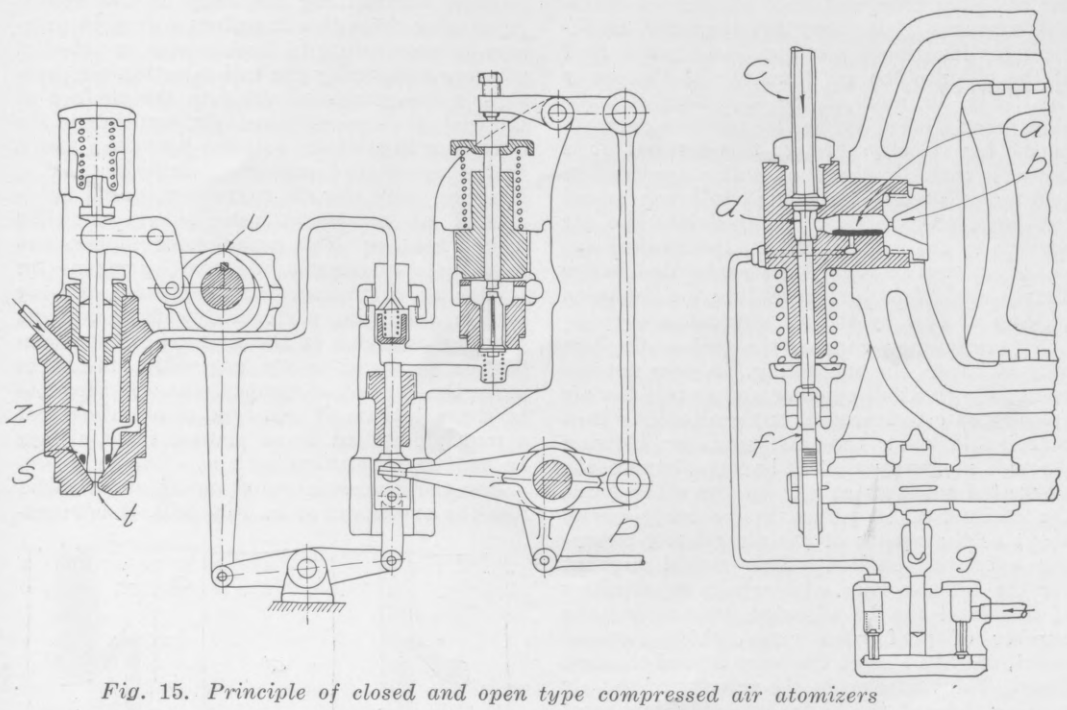

Fig. 15. *Principle of closed and open type compressed air atomizers*

ing subject to regulation. Airless injection and air-spraying machines are alike, so far as governing by fuel quantity is concerned.

An important distinction nevertheless exists between the two, as regards the operation of the fuel pump. Whereas, in the airless systems, the fuel pump is the primary atomizing agency, the pumps used on air injection machines are not connected with, and have no influence on, the atomizing process. The air blast and the passages through which it flows in picking up the oil fully determine it.

The blast valve (*z* or *d*, Fig. 15) is always mechanically operated by means of cams (*f*, *u*) or equivalent positive mechanism. As will appear later, these valves are timed to open only a few degrees ahead of the dead center, because the atomization produced by the air blast is exceedingly thorough and results in ignition so quickly that the real time lag has not, so far as is generally known, been measured. Hence an air injection engine is more sensitive to timing changes than the airless injection type or even than a spark-ignited gas engine, a characteristic which would rule out the use of the injection air supply as a pneumatic means of operating the blast valve. Starting valves are sometimes so operated, but only because a 5 deg. variation in the timing is not likely to have serious consequences.

The location of the fuel-deposit cavity—whether between the blast valve and the cylinder (Fig. 15, *a*) or between the blast valve and the source of compressed air (Fig. 15, *s*)—is responsible for two broad classifications observed among injection systems using compressed air. When the cavity is placed between the valve seat and the cylinder space, it must naturally be in constant communication with the latter, the arrangement thus characterized being known as the open-nozzle sprayer (*a*, Fig. 15). When the location of the cavity is such that it communicates with the cylinder only so long as the blast valve is open, the designation closed-type is generally applied. A comparison between the two can more easily be made after the main characteristics of each have been noted.

Fuel is deposited at *a*, Fig. 15, towards the end of the expansion stroke in 2-cycle engines and during the exhaust stroke in 4-cycle machines. As the timing of the fuel pump plunger is such that the delivery of oil is complete before compression has begun or backed up very much through the orifice *b*, no serious demands are made upon the fuel pump in the way of overcoming pressure. The pump (*g*) may, therefore, be lightly and cheaply built, and is easily regulated with the requisite degree of precision by means of the governor or hand control.

After delivery by the pump the oil charge lies as a small stationary pool in the bottom of the cavity *a* until a blast of compressed air, admitted via valve *d*, sweeps it up and carries it in the form of drops through the spray orifice *b*. Owing to the sharp increase in air velocity occurring at *b*, the drops are subdivided into minute particles, according to the process already indicated (Chapter II, Fig. 3), leaving the spray tip *b* the oil-bearing air jet still has sufficient energy to scatter small particles far and wide throughout the "combustion air" compressed to about 475 lb. per sq. in. within the cylinder clearance space. The latter statement probably applies with greater accuracy to the single, well-rounded orifice shown in Fig. 21B, *m*, *n*, than to the multiple orifice sketched in Fig. 21A, *e*, *f*. Importance is attached by some engineers to the fact that the oil, being exposed to the heat of the compressed air backing in through *b*, tends to vaporize some of it, so that combustible gas, rather than liquid fuel particles, is apt to be projected into the cylinder first. Criticism of the arrangement is based mainly on the somewhat indefinite blundering action with which the air blast takes up the oil, and the valve is therefore regarded by many as being incapable of that fine regulation required to prevent sharp pressure rises and ignition shocks within the cylinder. At any rate, the combustion produced by the open-nozzle sprayer does not seem to respond in a sensitive way to such changes as alterations in the form of the cam *f* driving the blast valve, nor to other adjusting operations, such as changes in fuel characteristics and operating conditions frequently made necessary. However, the open nozzle seems to be far cheaper to build than most of the other spray valve types and its use on light-duty horizontal engines has become fairly widespread.

A typical closed nozzle with fuel cavity situated above the valve seat is illustrated by the cutaway model assembled in Fig. 16 and detailed in Fig. 17. One of the most pronounced points of difference from the open nozzle just discussed lies in the use of baffle plates for holding the fuel, an expedient rendered possible by their isolation from the combustion space. The mode of working, as well as the general basis of design, is the same as that of the spray valve, whose full assembly is reproduced in Fig. 18, the most important

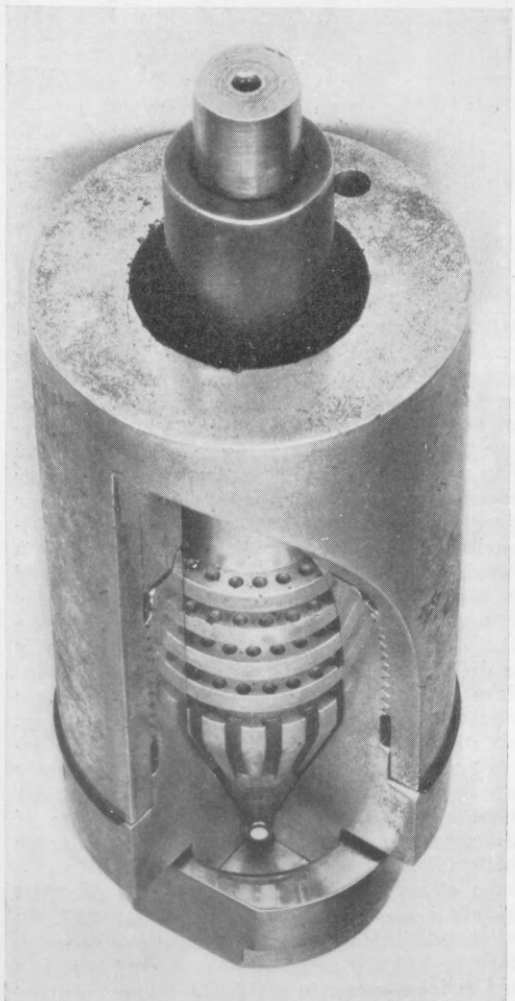

Fig. 16. *Assembly of atomizer model*

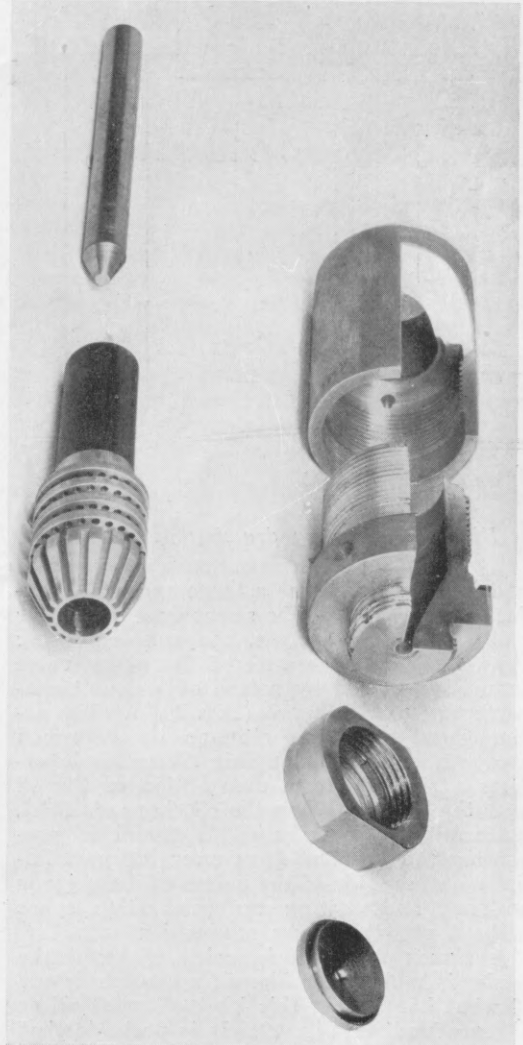

Fig. 17. *Air atomizer details*

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difference being that the spray valve represented by the model has a separate screwed-in base.

Fuel delivered through the drilled hole in the wall of the spray valve cage finds its way to the space left above the threads, clearly shown in Fig. 16. After flooding the latter, it uniformly overflows the sharp upper lip of the screwed insert, running down over the perforated ring baffles surrounding the needle guide. As the charge of oil handled is ordinarily about the size of an ordinary Concord grape, it is insufficient to fill the space around the baffles. If the oil is very thin, say like kerosene, some of it may find its way to the point where the needle is ground in; in general, however, the oil merely wets the baffles

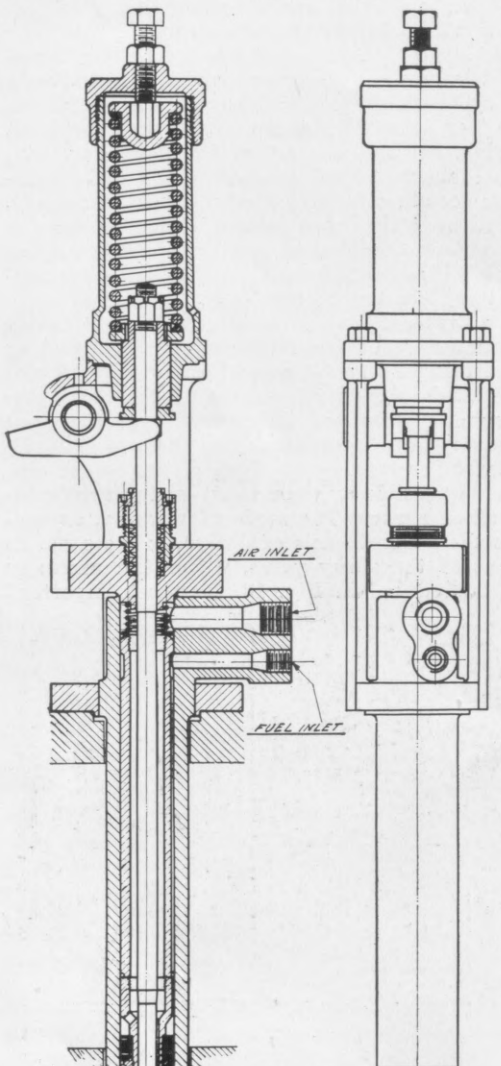

Fig. 18. *Working drawing of atomizer*

and is spread out over a large aggregate surface, subsequently to be swept over by the air blast. In some designs, the hole conveying the oil through the wall of the spray valve cage is connected by means of a drill transverse to the baffle-space (Fig. 20A). The arrangement with the circular lip described above is considered superior, because it effects a more uniform distribution of the oil over the baffles. When the oil charge is light, uniformity of distribution is useful in preventing the air-blast from sweeping past initially on that side of the baffles where there is no fuel, and chilling the combustion space without producing any combustion.

A sketch which is intended to assist the reader in making for himself a mental picture of what happens in this kind of an atomizer is reproduced in Fig. 19. It is probable that the baffles are important not so much for producing a break-up of the oil as for preventing the air blast from suddenly picking up excessive amounts of it; they are regarded as devices for insuring a more or less gradual feed of the oil into the air stream. At the spray tip *f*, Fig. 19, most of the atomizing is probably accomplished by the tremendous increase in the air velocity through this section. It is probable that the atomizing action produced at this point is energetic enough to break up all but large slugs of fuel dropped into the air current by the baffle-plates *c*. It therefore appears rational to regard the perforated baffles simply as devices for preventing too sudden a pick-up of fuel by the air current.

No matter how sharply the fuel needle cam may be timed, the end *h*, Fig. 19, does not immediately give full opening and causes the air velocity at *c* to increase but gradually. It is conceivable that the air may be blowing through so gently that it hardly disturbs the oil-wetted surfaces at all; on the other hand, the amount of oil picked up probably varies about as the square of the air velocity sweeping over the baffles. This would account for the relative ease with which an atomizer of this kind can be adjusted, by varying the number of perforated rings, their distance apart, and the size of the holes drilled through them. The variation in the velocity of the air passing through the baffles probably does most of the adjusting needed, by virtue of its rapidly increasing oil-convection. When the needle first begins to lift, a few degrees before top dead center, the piston is substantially at rest and only so much fuel should be fed as will barely start combustion. As the piston picks up speed on the down stroke, fuel should be fed at a rapidly increasing rate, in order that the heat liberated by combustion may be sufficient to neutralize the pressure-drop due to expansion. The general effect of rising air velocity caused by increasing needle lift would be to cause a more active pick-up of the oil, and thus to accelerate combustion in the manner needed to produce the characteristic "flat-top" Diesel indicator card (*m*, Fig. 22V).

The action as thus outlined for the perforated-baffle atomizer is probably also realized in the spray valve sketched in Fig. 20A, the most important distinction of the latter being its downward-opening or mushroom poppet valve replacing the inward-opening needles more commonly used. It is preferred by some designers because it moves in the same direction as the inlet and exhaust valves, therefore requiring no reversal in the cam motion. In its favor the claim is also made that its large seat-circumference favors a more general distribution of the fuel throughout the combustion space. As the pressure acting on the valve is slightly unbalanced during ignition in the direction of forcing the entire mass outwards, a less powerful spring than that commonly used for needle valves may be employed, while accidental pressure rises, such as those due to pre-ignition within the cylinder, have a tendency to slam the valve shut, rather than to encourage it in sticking open. Both the conical surfaces *a* and *b* are ground in and, as *b* is a portion of a slender cone, the amount of exit area (*c*) is comparable to that obtained in the needle-type atomizer by means of the flame plate. Another effect claimed for the slender cone *c* is that it tends to make the valve less sensitive to changes in the valve lift—a motion which is inclined to be very small in any case, because of the poppet's large area.

In some forms of atomizer (B and C, Fig. 20) the pressure effects of the flowing air are utilized to produce a gradual feeding of the fuel into the air stream. Fuel entering through the drilled passage *m* rises in the passage *i* and drilled holes *h* and *g*, not quite overflowing at *s*, while the valve is shut and no air passing. As soon as the needle is lifted off its seat, air from the space *d* flows through the holes *f* and picks up considerable velocity in the constricted portion *s* of the annular passage surrounding the body of the needle. In passing through *s* it suffers a drop in pressure corresponding to its increase in velocity, whereas practically the full injection air pressure is communicated via *f* to the surface of the fuel oil standing there. In response to the difference in pressure existing between *j* and *s*, fuel rises in the numerous drilled holes *g*, mingling with the air current at *s* and being ejected at maximum velocity via multiple drilled holes *n*. This arrangement appears to be a more systematic and positive means for producing a gradual fuel feed into the air stream than the perforated baffles; but its practical influence on the character of the combustion produced in the engine is difficult to make the subject of comparisons. It seems to be characteristic of this type of atomizer that a multiple drilled flame plate *n* must always be used in connection with it.

For the successful working of an atomizer like the one sketched in Fig. 20B, it is essen-

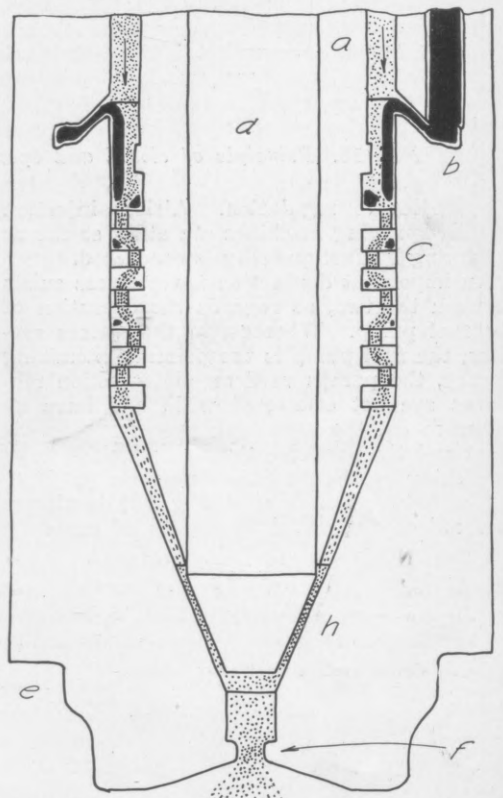

Fig. 19. *Spray valve action*

tial that a fairly high velocity be established at the "feeding cross-section" *s* in order to obtain the pressure drop there, which is essential to make the fuel rise through the holes *g*. An enlarged cross-section, such as *i*, is therefore provided further along in order to insure that *s* will unmistakably be the point of greater velocity and lower pressure. As the number of square inches allowed at *s* and *i* are primarily fixed by the conditions of securing a certain rate of fuel feed, the establishment of an air velocity adequate for pulverizing the oil must be insured elsewhere, this being the multi-jet burner plate *n*. It would probably be difficult in this case to use a single-orifice plate like the one shown at Fig. 20C, because the single hole would have to be kept too large for atomizing purposes, in order to insure active flow of air at *s*. By using a sufficiently large number of relatively fine drilled holes at *n*, an acceptable balance between rate of feed and degree of atomization appears to be obtainable.

An effect generally similar to the one just described is produced by atomizer 20C, in which fuel is delivered via *u* into the space *v*. Nothing but the small dimensions of the ring gap *w* is apparently available for preventing the fuel from flowing by gravity through the milled flutes *v* and collecting as a solid pool

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above the needle seat. If the oil is thick enough, a certain amount of it will remain hanging in the gap *w* and will be fed into the air current by pressure excess existing at *v*. The main current entering via *t* is directed backward by the sharp lip *x* and meets the fuel being forced into it through the gap *w*.

An apparently later development of this form of atomizer (used on German U-boat Diesel engines) is sketched in Fig. 20D. Fuel is lodged at *aa*, being prevented by the small milled gaps *bb* from entering too freely into the space *dd*. However, as soon as the needle is lifted, excess pressure at *aa* forces the fuel to pass into the air stream, rapidly accelerated with a corresponding pressure drop through the narrow passage *dd*. The success of this atomizer also seems to be conditional on the use of a multi-nozzle burner plate *ff*.

Comparison of the air atomizers described thus far, with one another, and with the large

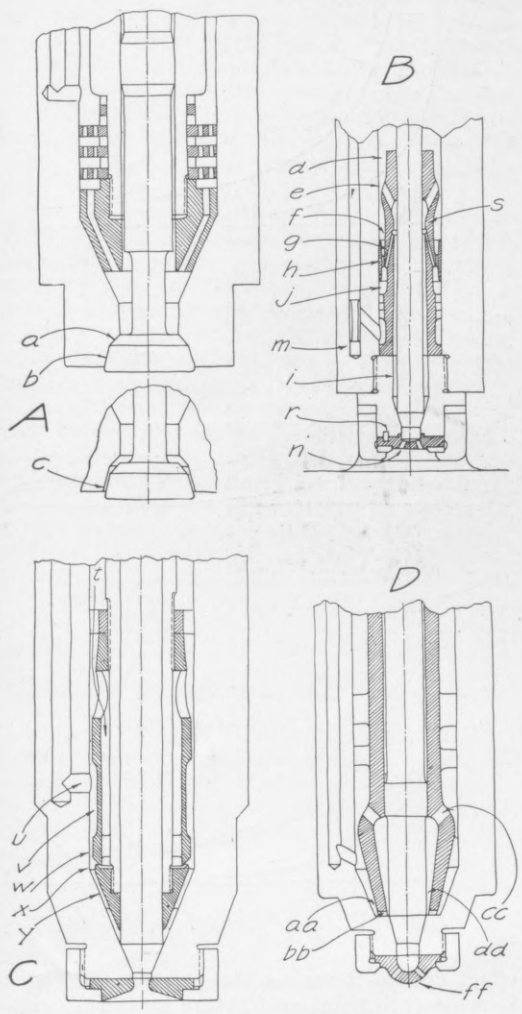

Fig. 20. *Typical air atomizers*

number of other spray valves found in practice, is rendered difficult because a direct observation of their action is next to impossible, only the shape of the indicator card which they produce, the fuel consumption observed in the engines to which they are fitted, and the accompanying exhaust temperatures being available as circumstantial evidence.

Other things being equal, however, it would seem as though that atomizer is best which most efficiently converts the pressure of the injection air into the kinetic energy represented by the break-up of the fuel and its distribution throughout the combustion space. All the types considered are about on a par, so far as their ability to control the rate of fuel feeding is concerned, and it appears also that the exquisite fineness of drop size can be produced in them without resorting to excessively high injection air pressures. The greatest differences among them seems to lie in their varying ability to project the atomized mixture into the combustion space and to set up essential air turbulence.

The burner plate, sometimes known as a spray tip, is nothing more than a jet-producing nozzle or orifice whose effectiveness for producing a stream of maximum kinetic energy is subject to the same general conditions as those governing any other nozzle discharging an expansive fluid.

The simplest form of a nozzle consists of a hole drilled through a wall of metal and retained with the sharp edges, *a* and *b*, Fig. 21, left by the drill. The stream of air is sharply contracted at *a* and sets up eddies representing a considerable loss of energy. Further unsteady variation in the cross section of the moving stream occurs during the movement of the stream through the drilled hole, and it finally emerges with a diameter *c* considerably less than that of the hole *d*. The ratio c/d may be as small as 0.6; it is known as the coefficient of contraction and may be regarded as roughly proportional to the efficiency of the nozzle as an energy converter. The smaller the diameter of the hole and the higher the velocity of the air passing through it, the greater is the proportionate effect of sharp or insufficiently rounded entrance and exit sections.

Although it is possible to make, say, five holes, whose combined discharge will be the same as that of a single larger hole, the sum total of the energy of five jets will be considerably less than the energy of the single jet. It is more than likely, also, that five jets will individually loose themselves in the dense air of the combustion space (Fig. 21A), and will not cooperate to effect the same degree of turbulence and distribution, as a single more powerful jet (Fig. 21B). Logic therefore seems to favor the view that multiple orifices defeat their own ends as agencies for promoting distribution of the fuel (*g*, Fig. 21), and do not set up so effective a mixing action in the far corners of the combustion space as does the single large-bore orifice (*h*, Fig. 21B).

Another objection sometimes urged against the multiple small-bore orifices is that they lend themselves less readily to reaming and tapering operations necessary to make them like efficient nozzles having gradual entrance and exit section changes. A small amount of carbon deposits is much quicker to make these operations useless when performed on the smaller holes. A single nozzle plate, on the other hand, may be conveniently rounded as indicated at *m* and *n*, Fig. 21, to produce contours similar in principle to those used on the most efficient steam-turbine nozzles (*j*, *k*). Good rounding of the entrance and exit sections almost entirely eliminates the contraction effect, giving the nozzle a coefficient higher than 0.95. The comparison of this figure with the 0.6 estimated for the square-edged orifice is a fair index of their relative efficiencies.

It is not necessarily to be inferred from the foregoing that nozzles like *B* and *D*, Fig. 20, would be improved by substituting single-hole burner plates for the fittings used on them. For it has been observed that whenever ring gaps like *s* or *bb* are used in place of perforated baffles, it is difficult to give the atomizer as a whole sufficient resistance without the use of multiple orifices. The question to be decided is really whether the ring gap atomizers, *B*, *C* and *D*, Fig. 20, are enough superior in other respects to compensate for the need of using the "salt shaker tips" (Fig. 21A) which they appear to require.

An atomizer like the one illustrated in Fig. 16 was used for injecting fuel in the world's largest-bore Diesel engine, a cross section of which is reproduced in Fig. 22. This is an experimental 2-cycle engine developing 2000 b.hp. in a single cylinder of 39.4 x 43.3 in. bore and stroke dimensions at 115 r.p.m. The diameter of the hole in the burner plate was 14 mm., or more than half an inch. Surely if it is possible to supply so wide an expanse of combustion space as that illustrated in Fig. 22 with a single hole, there would appear to be little justification for the use of finicky arrangements like that sketched at Fig. 21A.

According to J. Magg, author of "Valve Gears for Internal Combustion Engines" (Die Steuerungen der Verbrennungskraftmaschinen, Julius Springer, Berlin, 1914), the diameter of burner plates like the one sketched at *m*, *n*, Fig. 21, may be determined by the formula

$$d = (0.0176\sqrt{HP}) \text{ in.}$$

the results being applicable presumably to 4-cycle single-acting engines up to 150 b.hp. per cylinder. For 2-cycle single-acting cylinders the formula would read

$$d = (0.0124\sqrt{HP}) \text{ in.}$$

This, when applied to the 2000 hp. cylinder of Fig. 22, would call for an orifice diameter of 0.554 in., a result agreeing closely with the

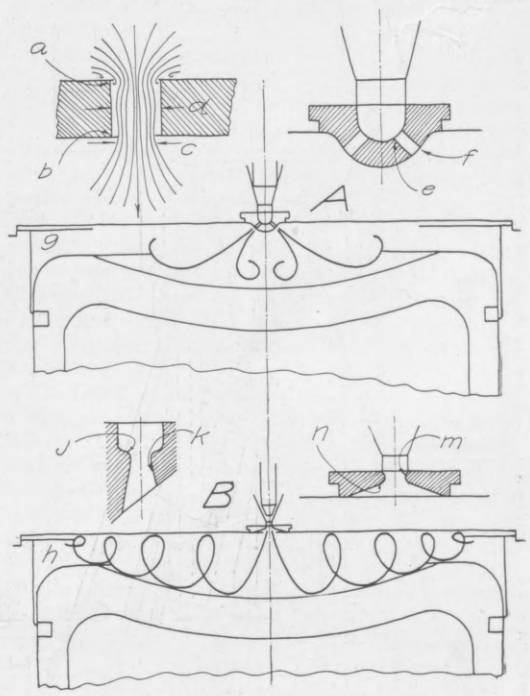

Fig. 21. *Single and multiple orifices*

14 mm. (0.552 in.) quoted by an official of the builders' firm.

The lift of the needle, according to Magg, should be the same as the diameter of the burner plate hole, provided that the angle of the cone seat is 45 deg. Blunter needles than this require lower lifts (with a proportionately greater degree of accuracy in the cam drive), while more slender needles require higher lifts and are correspondingly less sensitive to errors produced by slack, expansion of the mechanism because of heating, etc. If needles with a total seat angle differing from 45 deg. (22½ deg. on each side of the centerline) are used, their lifts are to be modified proportionately to $\sin \frac{A}{2}$, A being the total seat angle. These values are believed to represent as good an average as can be obtained for quantities so susceptible to influence by many other conditions.

The factor having the profoundest influence on the working of any air-injection device is the pressure of the compressed air used to operate it. Obviously, this pressure must always be greater by a safe margin than the maximum pressure set up in the cylinder as the result of compression or combustion. In the interest of reducing compressor maintenance, on the other hand, pressures no higher than those required to give maximum combustion efficiency should ever be used.

Injection air pressures are varied mainly for two reasons, one of these being to allow for changes in the viscosity of the fuel oil reaching the atomizer and the other being to modify the injection process to suit varia-

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tions in the amount of power developed by the cylinder.

The expansion of the injection air, as pointed out in an earlier chapter, has a tendency to produce a sharp refrigerating effect, calculated by some engineers to give freezing temperatures in the Diesel engine cylinder. Practical importance seems, however, to be attained by this phenomenon only when the engine is running idle or at extremely light loads. Under these conditions the amount of fuel injected is so small that a blast of air may easily get ahead of it and chill the combustion space below the point where the later entry of the fuel can cause ignition.

In all the air atomizers discussed so far, the chilling difficulty is readily overcome by decreasing the supply of injection air (bleeding from the injection air bottle and throttling the atmospheric intake of the compressor) in accordance with the reduction in the power developed by the engine. With increasing load, naturally, the injection air pressure must be raised again. It is difficult to state rules for injection air pressure variation, but the values represented by the curves in Fig. 23 are believed to give successful operating conditions with most of the air atomizers generally found in practice. If marked departures from the values shown in Fig. 23 are required to make the engine run, some abnormal condition (clogged atomizer parts, leaky spray valve, etc.) should be found out and corrected.

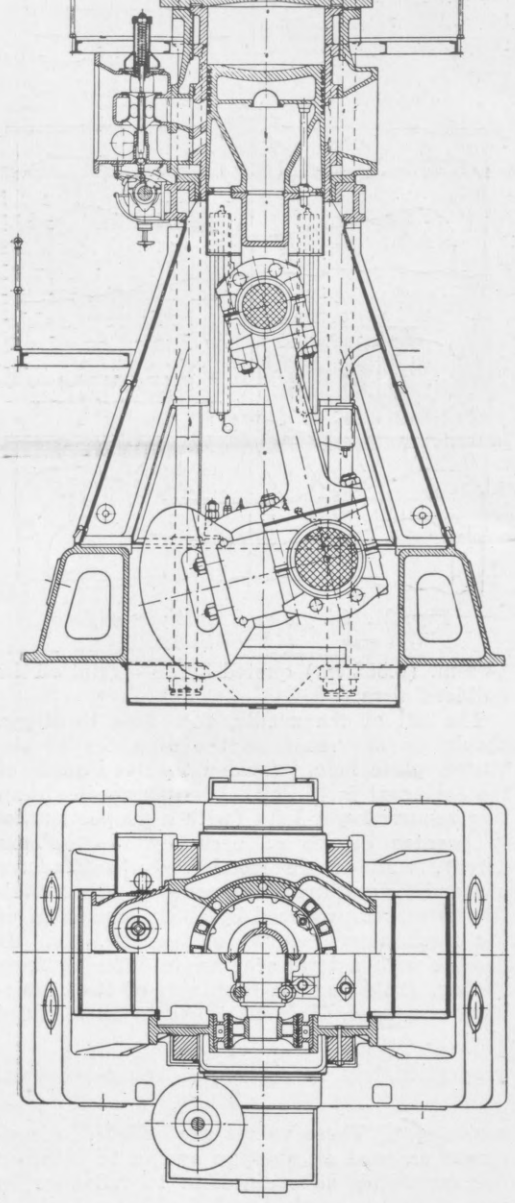

Fig. 22. Diesel cylinder of 39.37-in. diameter

Curves like those shown in Fig. 23 are best determined for each installation by holding the injection air constant at several different pressures, while the percentage of load (or speed of the ship, in the case of a marine engine) remains substantially without change. If then a curve is plotted with injection air for the horizontal scale and fuel consumption per hour as the vertical, a curve with a low point will be obtained at a certain value of the injection air pressure. This marks the pressure at which cleanest combustion and minimum compressor power will be realized. In the case of the marine installation, the peak of the r.p.m. curve for dead slow, slow, half speed, and full speed gives the clue as to the best injection air pressure to be used with each one.

It is apparent that satisfactory combustion in an air-injection cylinder is the composite product of a considerable variety of adjustments, settings, pressures, and the like, the sterling-silver-mark for which is generally considered to be the so-called "flat-top" indicator card drawn at *m* in Fig. 22V. The designation "flat" is more or less of fiction, justified in so far as it conveys the fact that the pressure rise incident to ignition and combustion is not very great, and that it is maintained without much variation over about 1/11 of the stroke. The common sense of the matter seems to be that extremes of pressure rise or pressure drop accompanying combustion are undesirable and are avoided by the prudent engineer in making his settings.

Outside of injection air pressure, the timing advance with which the cam mechanism for the fuel needle is set to operate affects the shape of the combustion line on the indicator card in the most sensitive manner. Increases in the injection pressure and in the number of degrees' opening lead both tend to elevate the combustion line, other things being equal, while decreases in either of these quantities—degrees of timing advance or of injection air pressure—tend to depress it. Medium-speed engines with single-orifice injectors (Fig. 16, 20A) generally run with 4 deg. timing advance on the fuel cam, whereas multiple orifice injectors (Fig. 20B, 20D) have somewhat greater leads (about 6 deg.) corresponding to the smaller amount of injection energy liberated from the small sharp-edged drilled holes. Fuel valves generally close at about 40 deg. after the dead center (Fig. 22V, *b*), a point corresponding to about 15 per cent of the stroke. It would appear from Fig. 22V as though combustion ceases much earlier, because the pressure fails to hold up any longer after the point *c* is reached. The three objects to be attained by keeping the fuel needle open for the length of time stated would appear to be as follow:

To accommodate overloads.

To insure that the atomizer will be swept reasonably clear of oil, otherwise successive remnants might be added to each new incoming charge and cause flooding up to the point where large slugs of unatomized oil would be plugged into the cylinder.

To promote maximum thoroughness of combustion. There is reason for believing that combustion is sluggish when unassisted by the turbulent action of air streaming out of the injection orifice (Fig. 21B). Tests show that combustion is by no means at an end, even when the point *b* (Fig. 22V) is reached, hence it would appear desirable to keep the injection air going as long as excessive demands are not being made upon the air compressor. Experience indicates that a continuation of the blast beyond the point *b* producers more wear and tear on the compressor than is justified by the improvement in combustion.

Returning to the question of pressure rise attending combustion, it may sometimes be found puzzling to tell how much of it is due to early timing and how much to excessive injection air pressure. Normally the pressure rise should amount to about 50 lb. per sq. in., while cards showing the real flat top with zero pressure rise should be looked upon with suspicion. When the ignition pressure exceeds compression by 100 lb. or more, a card like that shown at *e*, Fig. 22V, is likely to be produced; it is generally smooth in outline and produces accentuated noises in the cylinder only when there is some mechanical fault, such as excessive piston clearance or a loose wristpin. Pressure rise due to excessive injection air pressure, on the other hand, is generally characterized by a peaked or jagged line similar to that shown at *d*, and often produces a noticeable sound inside the cylinder. Frequently the excess injection air and refrigerating

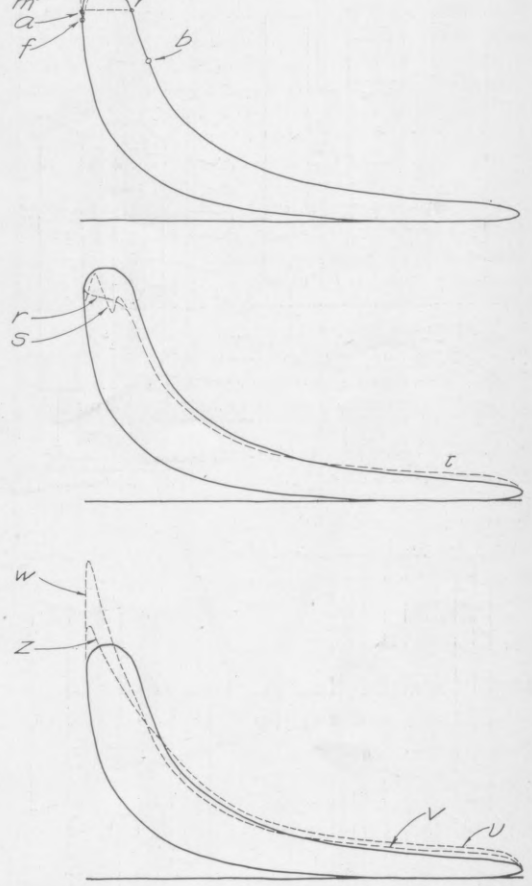

Fig. 22V. Air-injection diagrams

effect due to it makes the pressure fall back to some such point as *f* before ignition begins. Assuming that the atomizer setting, nozzle plate, etc., are right, a reduction in the cam timing in the case of diagram *e* or a decrease in the injection air pressure in the case of *d* will bring the diagram back to the normal form denoted by *m*.

Efforts to correct a card like *d*, Fig. 22V, by changing the cam timing can immediately be recognized as futile by the fact that a very considerable shift of the cam-nose is necessary in order to produce any effect. When the air pressure is correct, on the other hand, the slightest change in the cam timing will raise or lower the combustion line appreciably. Late cam timing with correct injection air pressure often produces a card looking like *r*; the attempt to improve it by raising the injection air pressure generally produces some such combustion line as indicated at *s*. Efforts to get the combustion line above the constant pressure level are futile in this case, the only effect of the extra injection air being to destroy the smoothness of the combustion; it is useful, however, in showing the operator where the trouble lies. An effect like that produced at *r* may readily be due to a slacking off of the

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fuel needle tappet screw, an occurence which delays opening by allowing the cam to travel further before making contact with the roller. The indicator card may then be brought back to normal by judiciously tightening the tappet.

In most cases it will be found difficult to set the atomizer for a card like *m* (regarded by many as the ideal diagram) without causing the cylinder to emit a certain amount of sound at each firing dead center. A reduction of the cam timing advance to produce a card like *r* will generally eliminate all sound, but this is a practice not looked upon with favor. A card like *r* almost always has a fat toe, *t*, which is regarded as evidence that fuel is burning far down the stroke. As the temperature of the flame is lower, combustion cannot be so complete, and produces carbon as well as other undesirable combustion residues within the cylinder. On the other hand, although lower flame temperatures are produced than is the case with normal cards like *m*, their duration is longer and they make the cylinder, piston, and other engine parts run at high temperatures. Time is an important factor in the communication of heat from the gases to the surrounding metal. Hence the languishing flame produces a hotter, dirtier cylinder than the sharp flash of combustion ascribed to the indicator card *m*.

The operator therefore seems to be confronted with a dilemma, one horn of which seems to be sharp combustion with marked pressure rise, and the other smooth combustion with fouled and heated cylinders.

Force feed lubrication and modern designing methods, as has already been pointed out, seem to have made negligible the effect of moderately sharp pressure rises and shocks. But force feed lubrication has made modern oil engines more sensitive to contamination with carbon and combustion residues. A certain amount of blowing past the piston rings is inevitable. If the leakage products are laden with carbon and tar, they quickly intensify the condition, because these non-lubricants tend to stick up the piston rings and make them leak still more. Leakage, of course, is accompanied by loss of compression and a lowering of combustion temperatures, attended by the precipitation of more carbon and residues. They are in most cases extremely difficult to keep out of the force-feed lubricating circulation, where they probably do many times as much damage to the bearings as the slight pressure rises that would have attended clean combustion.

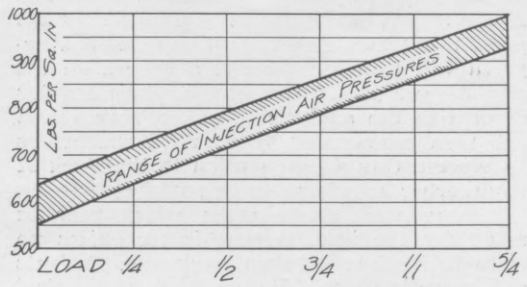

Fig. 23. Range of injection air pressures

As the result of many observations like the above, experienced Diesel engine operators are not satisfied unless they get indicator cards showing that combustion sets in promptly and is fairly well completed at a pressure level substantially higher than that of compression. They have found by actual test that such a routine of operation involves less bearing wear, fewer scored pistons, longer-wearing exhaust-valve seats and piston rings than a scheme of operation which tolerates smoky exhausts and high cylinder temperatures.

Multiple-orifice atomizers, Fig. 21A, are harder to set in such a way as to produce high-temperature combustion of short duration. Because of their inability to scatter the fuel violently about the combustion space, they are given earlier timing and produce fairly high pressure peaks shown exaggerated by Fig. 22V at *w*. This kind of pressure rise is sharply to be distinguished from the kind which is produced with a smaller timing advance (diagram *m*) and greater promptness in the supply of well-distributed fuel. The card *w* has no "holding power" because there is not enough air-turbulence in the cylinder to make the fuel burn as fast as is required to sustain the pressure. Such "salt-shaker" atomizers (Fig. 21A) probably feed the fuel fast enough, but do not sufficiently insure that the cylinder air is rapidly brought in contact with each atomized particle. Attempts to make fuel valves of this kind operate with smaller timing advance generally results in cards like *z* (Fig. 22V) having swollen toes as indicated at *u*. Here again a judicious choice would favor diagram *w* with the higher peak but thinner toe *v* as the lesser of the two evils.

Sluggish combustion and its many attendant ills may also be the consequence of a poor combustion space so full of nooks and crannies (Fig. 9C, Chapter II, that an adequate degree of turbulence cannot penetrate to them. In most of these cases there is no remedy but a change in design and the operator is constrained to help himself by means of advanced timing. Designers who are content with cards like *w* and *z* should not go to the trouble of using injection air, because the same, if not better results can be obtained in airless injection engines not burdened with an air-compressor.

Like any prime mover, the Diesel engine is a device for realizing the formula: Fuel + Air = Power. Atmospheric air is plentiful and cheap, except inside the combustion space of an oil engine, where the air represents a construction cost of $50 or more per hp. In the last analysis it is not fuel economy, but air economy that counts, the injection system which wastes least of the compressed combustion air being the most efficient.

Review of Recent Publications

Ocean Freight Rates in the United States and Foreign Trade

Prepared in the Transportation Division of the Department of Commerce, Washington, by A. E. Sanderson, and published as trade information. Bulletin No. 434. Price 10 cents.

Ocean Freight Rates in the U. S. Foreign Trade provides a handy reference on ocean freight rates for American shippers. Besides furnishing an outline of the structure of these rates, it provides a directory of the shipping lines engaged in our foreign trade, giving the names and addresses of both the lines and their agents; it also indicates the American and foreign ports served by each line and the class of freight carried. The directory of shipping lines is so laid out that the shipper may immediately locate the lines operating in any particular area. An appendix to the bulletin gives a specimen freight conference agreement and shows the United States legislation on shipping conferences and practices of shipping lines.

The Port of New York

Port Series, Report No. 20, the Port of New York, issued by the Board of Engineers for Rivers and Harbors of the War Department in cooperation with the U. S. Shipping Board. Issued in three parts. Obtainable from the Government Printing Office, Washington, D. C.

This unit of port series is the most exhaustive of the series and is issued in three parts—General Report, Statistical Data, and Maps. One volume gives a special series of maps of New York and its surrounding waterways, another gives full information with regard to port and harbor conditions, port customs and regulations, services and charges, fuel and supplies, facilities available for service to commerce and shipping, including piers, wharves, dry docks, ship repair plants, coal and oil bunkering, grain elevators, storage warehouses, bulk freight storage, floating equipment, wrecking and salvage equipment, railroad and steamship lines and their charges and practices in connection with terminal service. Foreign and domestic commerce is discussed, and tables are presented showing in detail the business of the ports during recent years. Information is given regarding the origin and destination of the foreign traffic, and there are maps showing the distribution by states and foreign countries. The third volume contains port maps.

Although this volume is No. 20 of the Port Series, it is only the sixteenth report to be distributed, Nos. 12, 15, 16 and 18 have not yet been completed for publication.

Sketches and Working of Oil Engines

By Julius Kuttner, B. Sc. 10¼ in. x 13⅞ in. 17 chapters. 166 illus. Price $3.50. Published by Freeman, Palmer Publications, 220 W. 42nd St., New York.

What is regarded as a considerable improvement over the standard textbook method of telling the oil engine story is embodied in "Sketches and Working of Oil Engines." Disregarding almost entirely the usual formalities of textbook writing, the author has addressed himself directly to the task of making his readers understand the whys and wherefores of oil engine operation and design. As the result of many years of practical contact with this form of prime mover, followed by a technical journalistic career also devoted to it, he has reached the conclusion that there is little about it which is intrinsically difficult to understand. If an impression has actually been created in some quarters that the oil engine is a complicated mechanism difficult for the layman, operator and general engineer to grasp, he feels that this is the fault of the method of attack rather than of the subject itself. His exposition of oil engines is therefore built around the idea that if he succeeds in imparting to the reader or student those items of information which are necessary for a complete and logical picture of the oil engine's structure and working, a natural and thorough understanding of the subject must follow as a matter of necessity.

No pains have apparently been spared by the author in accomplishing his purpose. He illustrates, defines and cites practical examples for every point he makes, repeating, but not in a tiresome way, instances of all those mechanical principles which have an especially direct application to oil engine work. It is apparent from the foregoing that the author has no time to write essays describing all the various types of engines with textbook finish and completeness. Anyone who thinks he can use the book as a catalog index of the oil engine available on the market today will find himself disappointed. Realizing the futility of keeping up-to-date a textbook on so rapidly changing a subject as modern oil engine types, the author aims his efforts to achieve completeness not at the engine forms, but at the oil engine way of doing things. That, of course, changes too in accordance with the notable progress being made by the oil engine industry, but not nearly so quickly as the engine forms themselves. It is an old saying among mechanical engineers

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that there are a thousand good solutions for every mechanical problem. But among the thousand solutions perhaps only ten fundamentally different principles will be represented and if the students grasp these ten principles there is no reason why their memories should be burdened with the remaining 900 applications. Upon meeting any of them in practice, the student's mind can generally be depended upon to react to them in an effective manner, provided there is no obscurity underlying fundamentals.

The sketch method of illustrating and emphasizing points is used by the author for sharply focussing the reader's attention. Because of his experience as an oil engine designer and of his facility at making free-hand pen-and-ink sketches, his illustrations achieve a degree of clarity and directness which is often lost when ordinary mechanical drawings are used for illustrating a textbook. No matter whether he is describing piston rings, bearings or fuel pumps, his accompanying sketch always lifts the particular subject clear of the mechanical maze under which the ordinary mechanical drawing usually buries it. Clear photographic reproductions illustrate the text.

Although the chapters had their origin in a course of instruction given by the author at the Polytechnic Institute of Brooklyn, N. Y., it would be a mistake to infer that he confines himself to the A B C of oil engines. Much of his material is highly original in character, although his matter-of-fact way of handling it makes it difficult to distinguish from the more obvious items of oil engine information which has gained general currency throughout the industry and which is presented with unusual force and clarity. His explanation of injection systems contributes an unusually keen analysis of fuel atomization and injection processes. His marshalling of the scientific and technical evidence concerning fuel injection as the process is now known may be regarded as masterly. It is unusual, also in that its author makes clear the situation about fuel injection generally without buckling on the stiff and padded uniform of higher mathematics.

However, mathematics is regarded as a convenient means to an end and is freely enough used when it contributes something to the understanding or simplifies a chain of reasoning. A clever use of figures is illustrated by the proof that piston ring gaps diametrically staggered will leak less than if arranged on the stop-stagger plan. In fact the entire chapter devoted to the analysis of piston ring action has been commended by qualified authorities as representing a contribution to the stock of engineering knowledge on this subject.

The greatest single claim which may be made for the book is that it recognizes no class-distinctions between engineers, students and operating men. Its appeal to mechanical common-sense is too frank and direct to stop and question the reader about his mental pedigree: it takes nothing for granted except ordinary intelligence and a sincere interest in the subject. Anyone who half-way meets the author of *Sketches and Working of Oil Engines* on this basis will be richly rewarded.

Catalog

Lidgerwood Utility Hoist.—A leaflet discussing the characteristics of a gasoline driven winch with a rope pull of 2500 lb. at 150 ft. per min. rope speed. Lidgerwood Manufacturing Co., 96 Liberty St., N. Y.

Mess Room Maxims and Fables

AND if you don't know very much about your own business, still you probably know more about it than anyone else.

Like an empty wagon, an empty head makes the most noise.

When an engine will not work right in the hands of all operators we grant that it is not much of an engine and when an operator is such that all engines in his charge fail to work right then he is not much of an operator.

A job that is done about right may be like a bee that is about dead. It probably has a sting left in it.

Before charging all engine troubles to poor fuel it is best to investigate the results obtained by others with the same fuel.

It is much easier to rig for a safe lift than to put a man back together after a piece of machinery falls on him and "busts him up."

He who has made a repair not wisely but too well is better by far than he who has made no repair at all.

It is said that we are fools to follow the sea. If there never were such fools, how many combinations would have been made such as those which made us were?

Because a man does not know how to do a thing is no indication that he will never learn, but when a man does not want to learn things that is an indication that he will never know.

When you have found an engineer satisfied with an engine that sounds like a stamp-mill, then you have found a lazy man.

More oil strainers become clogged up as the result of not being cleaned regularly than as the result of too much dirt in the oil.

If Ben Franklin was right about "Early to bed and early to rise," then the second assistant should have the health of a Bernarr-Macfaddenite, the wealth of an Israelite and the wisdom of a Solomonite.

A man's efficiency measured by his employer's standard is seldom the same as his own standard of value. However, the sum total of his achievement is the only true indication of his value.

We are not surprised to learn that a certain captain and chief engineer, after a hot discussion of what each knew about the other's work, once decided to change places and shortly thereafter the following conversation took place through the speaking tube: *Captain in the engine room:* "I'm going to have to shut this thing down for a while. How are you fixed on deck?" *Chief Engineer on the bridge:* "Go ahead. Shut her down. Ship's aground."

The difference between an overheated piston and an overheated man is that the former seizes and sticks and nothing will move it until it cools down, while the latter moves in circles and on vertical and horizontal lines simultaneously and no one can make him stay put.

The great similarity between them is that both are very troublesome while in their torrid state and not worth a tinker's dam until they have both been smoothed out and put back in normal condition.

Some of us may be *abnormis sapines* (wise without instruction), but most of us are wiser with it.

One flat tire makes all roads rough. Don't be a flat-tire.

However, when inflating yourself use good clean cool air. Hot air always decreases in volume when allowed to cool.

The engine responds quickly to the touch of a good capable engineer, but unfortunately the engineer does not always respond quickly to the fine performance of the engine.

Seems almost time someone commenced giving us some information about gyroscopic devices. They are fine for the deck force, but IF they get out of order see if the chief doesn't get a call.

Wish someone would come along with a couple of devices to do for the engineer what the radio and gyro have done for the deck force.

We have even heard, and are inclined to believe, that the job which is completely planned ahead of time is half done before a wrench or hammer is put on it.

Personal

D. W. R. Morgan, formerly engineer, condenser division, Westinghouse Company, has been appointed manager of condenser and internal combustion engineering of that corporation.

G. W. Brogan, Towson, Md., has been retained as advertising and merchandising counsel for the American Hammered Piston Ring Co., Baltimore. This became effective on Oct. 1.

Charles M. Schwab has been elected president of the American Society of Mechanical Engineers for the coming year. Charles L. Newcomb, Everett O. Eastwood and Edward R. Fish have been elected vice-presidents, and Paul Doty, Ralph E. Flanders and Conrad R. Lauer have been elected members of council. Erik Oberg, editor of *Machinery*, New York City, has been re-elected treasurer of the society.

Classified Advertisements

50 Cents PER LINE, 5 LINE MINIMUM, PAYABLE IN ADVANCE

AN EXPERIENCED DESIGNER AVAILABLE.—A thoroughly experienced Oil Engine Designer is available. His experience covers over 20 years of active designing work in Sweden, Germany and this country. He is 43 years old, well balanced and well read. He has worked for three well-known American manufacturers during the past ten years and has actively worked on the design of both air and mechanical injection oil engines. He wants to associate himself with a manufacturer who requires an experienced and efficient designing engineer. Address Box 643 MOTORSHIP, 220 West 42nd St., N. Y. C.

WANTED—Assistant Foreman for Assembling Room in large Diesel Engine Factory. Only men with experience in assembling heavy machinery will be considered. We want a pusher. Box No. 644, MOTORSHIP, 220 West 42nd St., New York, N. Y.

FOR SALE: Patent on reversing means applicable on Diesel or gas engines—any size. Does not involve sliding cams, gears, rollers or cross over valves. Box 645, MOTORSHIP, 220 West 42nd St., New York.

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